Special Insert! Resources, Ideas, and Tips for Contest Season 2021 – 2022

QST

ARRL The National Association for Amateur Radio®

November 2021 www.arrl.org

DEVOTED ENTIRELY TO AMATEUR RADIO

Achieve Your Goals!

QST Reviews

QRP Labs QCX-mini CW Transceiver Kit

SOTABEAMS External DSP Audio Filter

RigExpert Stick Pro 0.1 – 600 MHz Antenna and Cable Analyzer

Digirig Mobile Digital Mode Interface

CAR-RT LOTC-009 MIX COMAIL
000804621B W6BI F0 05/2025
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Meet the Advanced Technologies

VFO
146.520
TX01 RX01
DN
VOL
A
VFO
446.500
FM
B
M▸V
TX AUTO
MODE
YAESU
FT5D
F MENU
A/B
BAND
V/M
PMG
BACK
MIC

C4FM/FM 144/430MHz DUAL BAND
5W DIGITAL TRANSCEIVER

FT5DR

C4FM DIGITAL CLEAR VOICE
Clear and Crisp Voice Technology

AMS Automatic Mode Select

66 ch GPS

WIRES-X

Touch & Go OPERATION

microSD Card

Bluetooth®

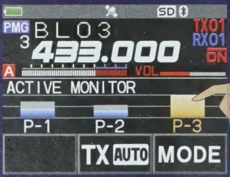
- ◆ Advanced C4FM Digital / 1W Audio Output
- ◆ Robust Tough Body with Rubber Protection
- ◆ Worldwide WIRES-X Internet Communications
- ◆ Fully Compatible with APRS
- ◆ Memory Auto Grouping (MAG) / VFO Band Skip Functio

《Actual Size》

Primary Memory Group Touch & Go operation

Touch & Go OPERATION

Quick & intuitive Touch and Go PMG key channel monitoring operation, by simply touching a bar on the LCD


SD
PMG
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P-3
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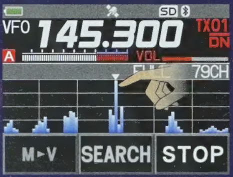
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VFO
145.300
TX01
DN
A
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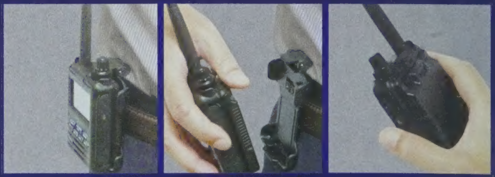
79CH
M▸V
SEARCH
STOP

Quick Release Holster and Full Flat-Back Case

Comfortable size & form with no protrusions provides excellent grasp, even when wearing gloves for outdoor activities



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The radio

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CA 90630 (714) 827-7600

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YAESU
The radio

C4FM/FM 144/430MHz Dual Band Mobile

High Visibility and Resolution QVGA Display with Exceptional Operability

Real Dual Band Operation V+V/U+U/V+U/U+V & Simultaneous C4FM Monitoring

FM Friendly Digital : AMS (Automatic Mode Select)

System Fusion II Compatible

WIRES-X Portable Digital Node Function

- *Wide Range RX Coverage : 108 ~ 999.99 MHz*
- *Easy to Operate II (E2O-II) : New User Interface for Easy Operation*
- *New Memory Auto Grouping (MAG) Function*
- *New Multi-Channel Standby (MCS) Function*
- *High-Speed 61 Channel Band Scope*
- *Easy Hands-Free Operation with Built-in Bluetooth® Unit*

C4FM/FM 144/430 MHz DUAL BAND
50 W DIGITAL MOBILE TRANSCEIVER

FTM-300DR

YAESU
1
2 ABC
3 DEF
4 GHI
5 JKL
6 MNO
7 PQRS
8 TUV
9 WXYZ
*
0
#
A
B
C
D
MUTE
P1
P2
P3
P4
YAESU
FTM-300D
GM
DX
A/B
V/M MW
BAND
VFO
13.8V
RX01
DN
146.520
VOL
VFO
446.500
FM
VOL
F SET UP
BACK
DISP
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New! Cushcraft R9 . . . *80-6 Meters*

R-9
$719.95
80-6 Meters
R-8
$619.95
40-6 Meters
Omni-Directional
low angle radiation
gives incredible
worldwide DX.

80 Meters . . . No Radials . . . 1500W

Cushcraft's world famous R8 now has a big brother!

Big Brother R9 now includes 75/80 Meters for local ragchewing and worldwide low band DX *without radials*!

It's omni-directional low angle radiation gives you exciting and easy DX on all 9 bands: 75/80, 40, 30, 20, 17, 15, 12, 10 and 6 Meters with low SWR. QSY instantly -- no antenna tuner needed.

Use full *1500 Watts* SSB/CW when the going gets tough to break through pileups/poor band conditions.

The R9 is super easy to assemble, installs just about anywhere, and its low profile blends inconspicuously into the background in urban and country settings alike.

Compact Footprint: Installs in an area about the size of a child's sandbox -- no ground radials to bury with all RF-energized surfaces safely out of reach.

Rugged Construction: Thick fiberglass insulators, all-stainless steel hardware and 6063 aircraft-aluminum tubing is double or triple walled at key stress points to handle anything Mother Nature can dish out.

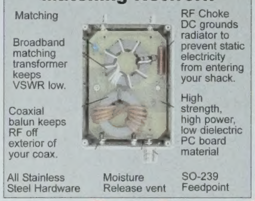
31.5 feet tall, 25 lbs. Mounting mast 1.25 to 2 inches. Wind surface area is 4 square feet.

R8, $619.95. Like R9 antenna but less 75/80 Meters.

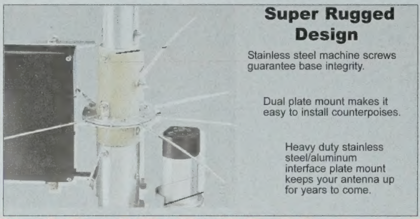
R-8TB, $109.95. Tilt-base lets you tilt your antenna up/down easily by yourself to work on.

R-8GK, $89.95. Three-point guy kit for high winds.

Matching Network


Matching
Broadband matching transformer keeps VSWR low.
Coaxial balun keeps RF off exterior of your coax.
RF Choke DC grounds radiator to prevent static electricity from entering your shack.
High strength, high power, low dielectric PC board material
All Stainless Steel Hardware
Moisture Release vent
SO-239 Feedpoint

Super Rugged Design


Stainless steel machine screws guarantee base integrity.
Dual plate mount makes it easy to install counterpoises.
Heavy duty stainless steel/aluminum interface plate mount keeps your antenna up for years to come.

MA-5B 5-Band Beam

Small Footprint -- Big Signal

The MA-5B is one of Cushcraft's most popular HF antennas, delivering solid *signal-boosting directivity* in a bantam-weight package. Mounts on roof using standard TV hardware. Perfect for exploring exciting DX without the high cost and heavy lifting of installing a large tower and full-sized array. Its 7 foot 3-inch boom has less than 9 feet of turning radius. Contest tough -- handles 1500 Watts.

The unique MA-5B gives you 5-bands, automatic band switching and easy installation in a compact 26-pound package. On 10, 15 and 20 Meters the end elements become a two-element Yagi that delivers solid power-multiplying gain over a dipole on all three bands. On 12 and 17 Meters, the middle element is a highly efficient trap dipole. When working DX, what really matters are the interfering signals and noise you *don't hear*. That's where the MA-5B's impressive side rejection and front-to-back ratio really shines. *See* ***cushcraftamateur.com*** *for gain figures.*

Cushcraft 10, 15 & 20 Meter Tribander Beams

Only the best tri-band antennas become DX classics, which is why the Cushcraft World-Ranger A4S, A3S, and A3WS go to the head of the class. For more than 30 years, these pace-setting performers have taken on the world's most demanding operating conditions and proven themselves every time. The key to success comes from attention to basics. For example, element length and spacing has been carefully refined over time, and high-power traps are still hand-made and individually tuned using laboratory-grade instruments. All this attention to detail means low SWR, wide bandwidth, optimum directivity, and high efficiency -- important performance characteristics you rely on to maintain regular schedules, rack up impressive contest scores, and grow your collection of rare QSLs!

It goes without saying that the World-Ranger lineup is also famous for its rugged construction. In fact, the majority of these antennas sold years ago are still in service today! Conservative mechanical design, rugged over-sized components, stainless-steel hardware, and aircraft-grade 6063 make all the difference.

The 3-element A3S/A3WS and 4-element A4S are world-famous for powerhouse gain and super performance. **A-3WS, $569.95,** 12/17 M. **30/40 Meter** *add-on kits* available.

Cushcraft Dual Band Yagis

One Yagi for Dual-Band FM Radios

A270-10S
$219.95

A270-6S
$179.95

Dual-bander VHF rigs are the norm these days, so why not compliment your FM base station with a dual-band Yagi? Not only will you eliminate a costly feed line, you'll realize extra gain for digital modes like high-speed packet and D-Star! Cushcraft's A270-6S provides three elements per band and the A270-10S provides five for solid point-to-point performance. They're both pre-tuned and assembly is a snap using the fully illustrated manual.

Cushcraft Famous *Ringos* Compact FM Verticals

W1BX's famous *Ringo* antenna has been around for a long time and remains unbeaten for solid reliability. The Ringo is broad-banded, lighting protected, extremely rugged, economical, electrically bullet-proof, low-angle, and more -- but mainly, it just plain works! To discover why hams and commercial two-way installers around the world still love this antenna, order yours now!

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and Nearest Dealer . . . 662-323-5803
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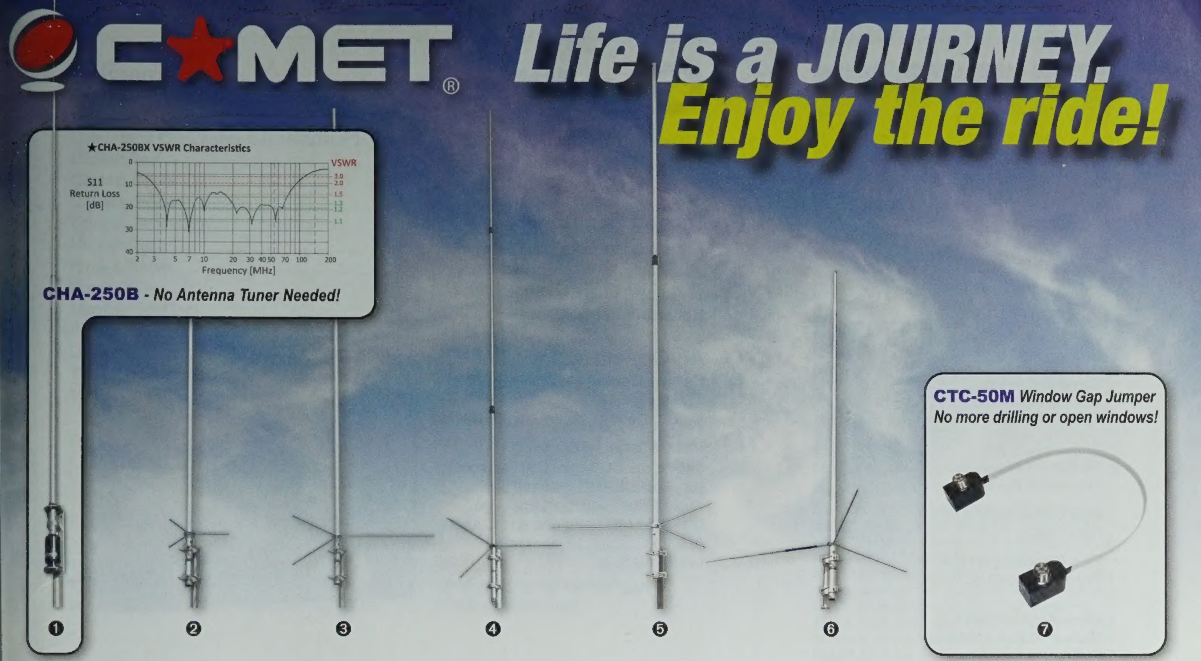

COMET®
Life is a JOURNEY.
Enjoy the ride!
★CHA-250BX VSWR Characteristics
S11
Return Loss
[dB]
0
10
20
30
40
VSWR
3.0
2.0
1.5
1.3
1.2
1.1
2
3
5
7
10
20
30
40
50
70
100
200
Frequency [MHz]
CHA-250B - No Antenna Tuner Needed!
CTC-50M Window Gap Jumper
No more drilling or open windows!
❶
❷
❸
❹
❺
❻
❼

Base Antennas

❶ **COMET CHA-250B** **BROADBAND 80M THROUGH 6M VERTICAL ANTENNA**
A newly designed broadband vertical with NO GROUND RADIALS. EXTREMELY easy to assemble, requires no tuning or adjustments and VSWR is under 1.5:1 from 3.5-57MHz! • TX: 3.5MHz – 57MHz • RX: 2.0– 90MHz • VSWR is 1.5:1 or less, continuous • Max Power: 250W SSB/125W FM• Impedance: 50 Ohm • Length: 23' 5" • Weight: 7 lbs. 1 oz. • Conn: SO-239 • Mast Req'd: 1" – 2" dia. • Max wind speed: 67MPH

❷ **COMET GP-3** **DUAL-BAND 146/446MHZ BASE REPEATER ANTENNA**
Wavelength: 146MHz 6/8 wave • 446MHz 5/8 wave x 3 • Max Pwr: 200W • Length: 5'11"• Weight: 2lbs. 9ozs. • Conn: Gold-plated SO-239 • Construction: Single-piece fiberglass

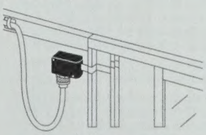
❸ **COMET GP-6** **DUAL-BAND 146/446MHZ BASE REPEATER ANTENNA**
Wavelength: 146MHz 5/8 wave x 2 • 446MHz 5/8 wave x 5 • Max Pwr: 200W • Length: 10'2"• Weight: 3lbs. 8ozs. • Conn: Gold-plated SO-239 • Construction: Fiberglass, 2 Sections

❹ **COMET GP-9 / GP-9N** **DUAL-BAND 146/446MHZ BASE REPEATER ANTENNA**
BEST SELLER! • Wavelength: 146MHz 5/8 wave x 3 • 446MHz 5/8 wave x 8 • Max Pwr: 200W• Length: 16' 9"" • Weight: 5lbs. 11ozs. • Conn: GP-9 Gold-plated SO-239 • GP-9N Gold-plated N-type female • Construction: Fiberglass, 3 Sections

❺ **COMET CX-333** **TRI-BAND 146/220/446MHZ BASE REPEATER ANTENNA**
Wavelength: 146MHz 5/8 wave x 2 • 220MHz 5/8 wave x 3• 446MHz 5/8 wave x 5 • Max Pwr: 120W • Length: 10'2" • Weight: 3lbs. 1oz.• Conn: Gold-plated SO-239 • Construction: Fiberglass, 2 Sections

❻ **COMET GP-15** **TRI-BAND 52/146/446MHZ BASE REPEATER ANTENNA**
Wavelength: 52MHz 5/8 wave • 146MHz 5/8 wave x 2 • 446MHz 5/8 wave x 4 • Max Pwr: 150W • Length: 7'11" • Weight: 3lbs. 1oz. • Conn: Gold-plated SO-239• 2MHz band-width after tuning (6M) • Construction: Single-piece fiberglass

❼ **COMET CTC-50M** **WINDOW GAP JUMPER**
Avoid drilling holes or leaving windows open/unlocked. Flat coax easily forms to window frame. Low loss SO-239 on each end, 15 inch length.
• Max Pwr: **HF** 100W PEP / **VHF** 60W FM / **UHF** 40W FM / **900-1300 MHz** 10W FM



146555
CAA-500
MarkII
1.8-500MHz
BAND
FREQ.
COMET
ANTENNA

CAA-500MarkII

1.8-500MHz Antenna analyzer

The CAA-500MarkII combines the simplicity and accuracy of an analog instrument, PLUS…a full color LCD graphic display • Resistive (R) and Reactive (X) components of impedance graphed and displayed numerically • SWR readings in both graphic and numerical results.

Operates on 8-16VDC external power, 6 AA Alkaline or NiMH rechargeable cells • Trickle charger built in (only when using NiMH batteries) • Typical battery life: 9 hours of continuous operation • Battery level indicator • Selectable auto power-off time limit preserves battery capacity • SO-239 connector for 1.8-300MHz range • N-female connector for 300-500MHz range

The perfect combination of analog and graphic information, designed in particular for antenna diagnostics and adjustments while on the roof, tower or in the field!

CAA-5SC

Protect your CAA-500MarkII from moisture, shock, dents and dings!

Shoulder strap included.

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Contents

November 2021 ♦ Volume 105 ♦ Number 11

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9 **Second Century**
Fall Into Contesting!

30 **The CW Game**
Robert Anding, AA5OY

33 **An Optimized Inverted L for 160 & 80 Meters**
George Cooley, NG7A

36 **Product Review**
Mark Wilson, K1RO
QRP Labs QCX-mini CW Transceiver Kit; SOTABEAMS External DSP Audio Filter; RigExpert Stick Pro 0.1 – 600 MHz Antenna and Cable Analyzer; Digirig Mobile Digital Mode Interface

A 7,030,00
B 7,040,00
QRP Labs QCX-mini CW Transceiver
VOL
TUNE
Rate
Message
Keyer
RIT
Menu
VFOA/B
Preset
A<->B

53 **The First Activation of Antsell Rock**
David Wise, KM3A

55 **The Beverage Antenna, 100 Years Later**
Ward Silver, N0AX, and Frank Donovan, W3LPL

58 **ARRL Board Returns to In-Person Meeting for Second 2021 Session**

★64A **Special Insert! Contest Season 2021 – 2022**

80 **Frequency Measuring Test — November 2021**
Ward Silver, N0AX

81 **The 2021 ARRL 160-Meter Contest**

81 **The 2021 ARRL 10-Meter Contest**

82 **The December 2021 ARRL Rookie Roundup — CW**

89 **A Look Back: January 1972**

★ 64A

QST
Contest Season 2021 – 2022
ARRL

Columns

Ask Dave 48
At the Foundation 82
Celebrating Our Legacy 93
Classic Radio 94
Contest Corral 79
Correspondence 24
Eclectic Technology 52
Happenings 61
Hints & Hacks 50
How's DX? 84
Member Spotlight 13
Public Service 77
Up Front 20
The World Above 50 MHz 86
100, 50, and 25 Years Ago 96

Departments

ARRL Section Managers 16
Certificate of Code Proficiency Recipients 64
Convention and Hamfest Calendar 88
Feedback 78
Field Organization Reports 78
Guide to ARRL Member Benefits 14
Ham Ads 124
Index of Advertisers 126, 127
Officers, Division Directors, and Staff 15
QST Cover Plaque Award 47
Silent Keys 97
Special Event Stations 83
Strays 35
Volunteer Monitor Program Report 88
W1AW Qualifying Runs 64
W1AW Schedule 28

QST
ARRL
Achieve Your Goals!
QST Reviews
QRP Labs QCX-mini CW Transceiver Kit
SOTABEAMS External DSP Audio Filter
RigExpert Stick Pro 0.1 – 600 MHz Antenna and Cable Analyzer
Digirig Mobile Digital Mode Interface

Our Cover

Ham radio's many sub-hobbies offer endless ways to challenge yourself. In this month's cover story, "The First Activation of Antsell Rock," David Wise, KM3A, details his progression from a beginner Summits on the Air (SOTA) aficionado to becoming the first ham (along with Scott Lindquist, N0OI, who's pictured on the cover) to activate Antsell Rock, in the San Jacinto Wilderness. Find further tools and inspiration for goal-setting in Robert Anding's, AA5OY, article "The CW Game," which offers a way to hone your Morse code skills, and don't miss this issue's special insert, "Contest Season 2021 – 2022," which is full of resources and hints to help you have your best radiosport season yet. [David Wise, KM3A, photo]

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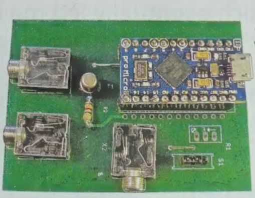
20

I THINK
THEREFORE
I HAM

30



50

94

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Advertorial

DIY Electronic Kits Changed My Life -- Now Arduino Kits Can Change Yours Too!

By: Steve Buffa (5 Minute Read)

When I was young, my family would gather for Sunday dinners at my grandmother's house. My uncle, who lived with my grandmother, had what he called his "Shack" in the backyard. Every evening after dinner he would leave the room saying, "Time to hit the shack". One night I asked, "What's in the shack?" What he did next changed my life forever!

"Instead of telling you, why don't I show you?" he said. As he opened the door to the shack, I remember the smell of solder in the air and being in awe of all of the electronic equipment everywhere. There were microphones, receivers, transmitters, tubes, resistors, capacitors, and inductors -- it was like a candy store for electronics lovers.

I was immediately drawn to one piece of equipment which looked half assembled. My uncle told me that this was a radio receiver that he'd purchased as a kit and was in the middle of putting it together.

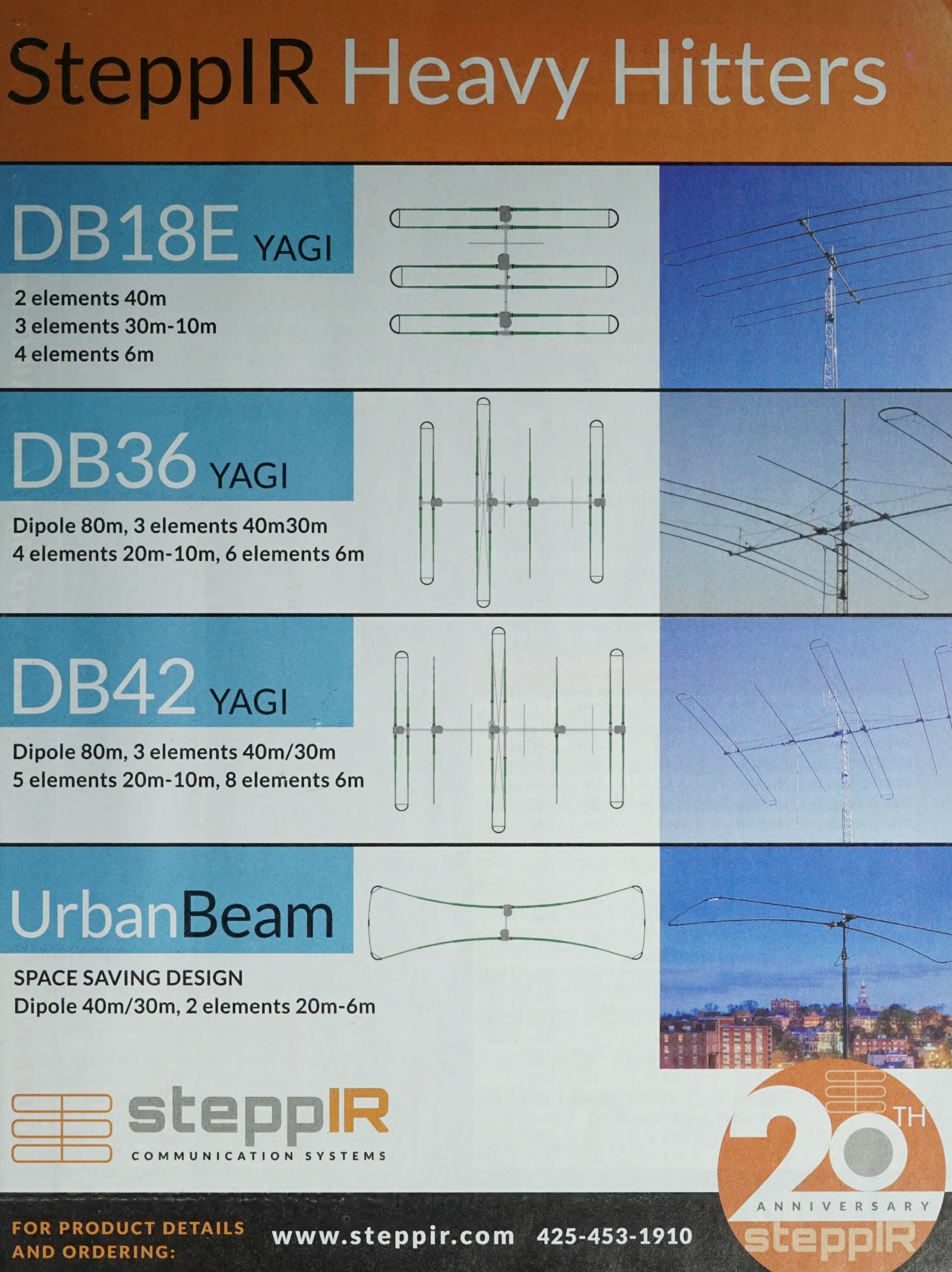
As he flicked on his soldering iron, he said that he had purchased prebuilt units before but, when something failed, he had no idea how to repair it. He said that by purchasing kits, he'd learned how they worked from the inside out. That was a turning point in my life! I spent the next few years assembling kits with my uncle, which eventually led me to a successful career as an electronics technician.

Dr.Duino Explorer Edition
Fun DIY Arduino© KIT
DR.DUINO
Explorer Edition
www.DoctorDuino.com

After I retired, I wanted to start learning how to add electronic control systems to my own shack -- things like a CW keyer or an automatic antenna switch -- but I had no idea how to do it. My friend Tom from my local ham meetup told me that I could do all of this and more with something called Arduino. This is a really simple microcontroller development platform that you can customize and program to make it do whatever you want. I looked around to find a good place to start, but I was inundated with all of the different vendor and kits. Where do I begin?

Luckily, I keep all my past issues of QST magazine and happened to see a review of a product called the Dr.Duino Explorer which is an Arduino compatible kit.

After reading this review, I knew that this was exactly what I was looking for. It comes as a DIY style kit accompanied by a superb set of step-by-step online instructions that teach you about the Arduino as you build it. PLUS, for a limited time, when you order your own Explorer Edition from www.DoctorDuino.com, you'll even get access to an Arduino Boot Camp for FREE! This is a mini course that starts by teaching you what you can and can't do with Arduino, and ends with you creating your very own Morse code machine! I'd hurry though, because it looks like this is only available to the first 200 takers!



SteppIR Heavy Hitters

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2 elements 40m
3 elements 30m-10m
4 elements 6m

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Dipole 80m, 3 elements 40m30m
4 elements 20m-10m, 6 elements 6m

DB42 YAGI

Dipole 80m, 3 elements 40m/30m
5 elements 20m-10m, 8 elements 6m

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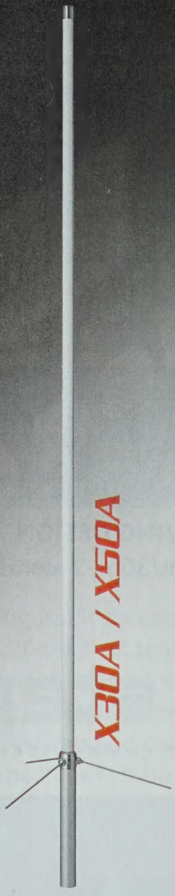
- Strong waterproof joint couplings
- Type-N cable connection
- Wideband performance
- Highest gain Dual-band Base Antenna!

Here is a small sample of our wide variety of antennas

Model	Bands	Length Ft.	Max Pwr. Rating	Conn.
Dualband Base Station/Repeater Antennas				
X700HNA (4 section)	2m/70cm	24	200	N
X510HD (3 Section)	2m/70cm	17.2	330/250	UHF or N
X300A (2 Section)	2m/70cm	10	200	UHF or N
X200A (2 Section)	2m/70cm	8.3	200	UHF
X50A (1 Section)	2m/70cm	5.6	200	UHF or N
X30A (1 Section)	2m/70cm	4.5	150	UHF
Monoband Base Station/Repeater Antennas				
F23H (3 Section)	144-174 MHz (W/ Cut Chart)	15	350	UHF
F22A (2 Section)	2m	10.5	200	UHF
CP22E (Aluminum)	2m	8.9	200	UHF
F718A (Coax Element)	70cm	15	250	N
Dualband Mobile Antennas				
SG7900A	2m/70cm	62.2 in.	150	UHF or NMO
SG7500A	2m/70cm	40.6 in.	150	UHF or NMO
NR770H Series	2m/70cm	38.2 in.	200	UHF or NMO
MR77 Series	2m/70cm	20 in.	70	Mag Combo
AZ504FXH	2m/70cm	15.5 in.	50	UHF
AZ504SP	2m/70cm	15.5 in.	50	UHF
NR7900A	2m/70cm	57 in.	300/250	UHF
Monoband Mobile Antennas				
NR22L	2m	96.8 in.	100	UHF
M285	2m	52.4 in.	200	UHF or NMO

NR770H Series

SG7900A


X30A / X50A

X700HNA

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David A. Minster, NA2AA, ARRL Chief Executive Officer, na2aa@arrl.org

Fall Into Contesting!

Autumn is my favorite season. It has always felt like renewal, new beginnings. And nothing makes that truer for me than the arrival of contest season. I've been contesting since I was a teenager. It was quite accidental that I met contesting. I was a new ham, with no experience whatsoever, trying to achieve Worked All States. I got on one weekend, and WOW! The bands were on fire. Stations everywhere, from everywhere. My states count looked like it would skyrocket, but what in the world were these ops sending to each other? 123 B WB2AAA 65 WNY? Well, of course, it was ARRL Sweepstakes. A call to a friend provided what I needed to know — before he slammed the phone down to get back to the contest.

And so began my love affair with contesting. Much of what I have learned about ham radio has come through the reading and operating associated with DX contests. I have been a longtime subscriber to ARRL's *National Contest Journal*, where many secrets of the "Big Guns" are shared, such as this simple one: "If you can't hear it, you can't work it." Makes perfect sense, so you'll see over the years many contesters make an effort to get just a few more dB of SNR to hear stations that are just below the noise, principally through advances in receiving antennas.

My call sign comes from a friendship and mentorship I enjoyed from contesting. Gene Walsh, N2AA, had a huge impact on me in my late teens and early 20s. He was a remarkably skilled and competitive operator. Most importantly, he had space in his life to give me pointers and advice. I met Gene as part of the Tuxedo Park contest station owned and operated by Hazard "Buzz" Reeves, K2GL. When my friend Doug, KR2Q, took me to the station as a teenager, he said, "After today, you will never look at ham radio the same way again." He was so right! It was there I fell in love with the style of contesting I still focus on today: multioperator.

I have had the opportunity to participate in multioperator events during myriad contests on HF and VHF from N2AA (@K2GL), N2RM, WA2SNA, NW2D, K2BAR, V26B, and most recently — and my favorite of all — PJ4G. I have met many people, and learned everything that I know today by partnering with these teams. I've worked stations using long path, skewed path, aurora, and even EME! Through incremental improvement to the stations and the operators, we were able to be constantly improving our capabilities.

This month in *QST*, we celebrate the beginning of contest season with our Contesting Supplement. We have partnered with the best contesters from some of the best contest clubs to bring you their advice: their learning and secrets to success. As you read through this section, the advice may seem too advanced, or may not even make sense. That's fine! Don't let that discourage you.

Make an upcoming contest experience your own. Set a simple goal, perhaps 50 or 100 contacts. Don't let the craziness of the beginning of a contest dissuade you. Come back later as things start to calm down. During DX contests, the last 8 hours are an easier time for getting on and operating. If you're working on WAS or DXCC, make a list of what you really want to work — and work it! Use dxwatch.com or a similar website for showing who is on, and from where. And don't be afraid to work QRP in a contest. I have done it, and even earned a plaque for one of my efforts! I only made 200 or so contacts over the entire weekend, but for QRP, it turned out to be a winning effort. Who knew?

So, fall into contesting. Give it a try if you haven't. And if you have, come back and enjoy operating. Yes, I know there are people who get upset when a contest interrupts their weekend plans for a net or a desire to DX, and the bands are a mess, or dead because "everyone" is using a different mode. This is where some patience and forbearance go a long way. Every contact counts. Every contact helps. Jump on and make even a few contacts to help the ops, the teams, who work all year for those precious few hours to compete with their fine-tuned stations. They're looking for you!

I have made lifelong friends through contesting. You'd be surprised how inclusive the community can be. So be *contest* active! Be a connector and get your friends or club to set some simple goals and get radio active — maybe even set up a little challenge between friends. With these being the early years of Cycle 25, the bands are only getting better.

NA2AA

David A. Minster, NA2AA
Chief Executive Officer

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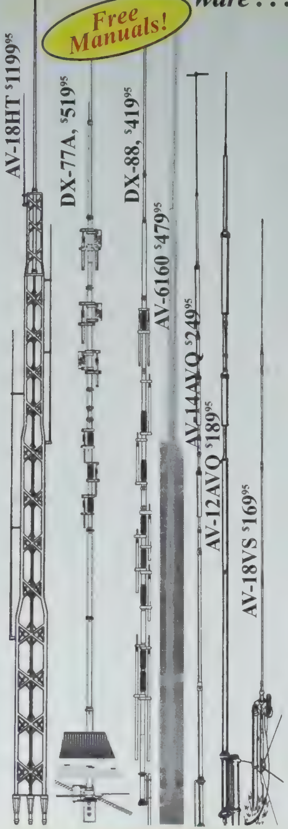

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Standing 53 feet tall, the famous *Hy-Gain HyTower* is the world's best performing vertical! The AV-18HT features automatic band selection achieved through a unique stub-decoupling system which effectively isolates various sections of the antenna so that an electrical 1/4 wavelength (or odd multiple of a 1/4 wavelength) exists on all bands. Approximately 250 kHz bandwidth at 2:1 VSWR on 80 Meters. The addition of a base loading coil **(LC-160Q, $169.95)**, provides exceptional 160 Meter performance.**MK-17, $139.95.** Add-on 17M kit. 24 foot tower is all rugged, hot-dip galvanized steel and all hardware is iridited for corrosion resistance. Special tilt-over hinged base for easy raising & lowering.

AV-18VS, $169.95 (10,12,15,17,20,30,40,80 Meters).18 ft., 4 lbs. High quality construction and low cost make the AV-18VS an exceptional value. Easily tuned to any band by adjusting feed point at the base loading coil. Roof mount with Hy-Gain AV-14RMQ kit, $139.95.

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AV-12AVQ, $189.95. (10, 15, 20 Meters). 13 ft., 9 lbs. AV-12AVQ also uses Thunderbird beam design air dielectric traps for extremely Hy-Q performance. Inexpensive triband performance in limited space. Roof mount with AV-14RMQ kit, $139.95.

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All bands are *easily* tuned with the DX-88's *exclusive* adjustable capacitors. 80 and 40 Meters can even be tuned from the ground without having to lower the antenna. Super heavy-duty construction. DX-88 OPTIONS: 160 Meter add-on kit, KIT-160-88, $199.95. Ground Radial System, GRK-88, $99.95. Roof Radial System, RRK-88, $99.95.

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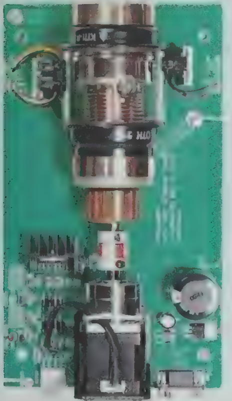

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Retaining all the great features of our HG3 PRO model, the new HG3 QRO high power (1.5 KW) model raises the bar again in magnetic loop antenna (MLA) performance. It covers 80*-10 meters. Adding the optional second radiator loop (two turns), allows full power operation on 80 meters.

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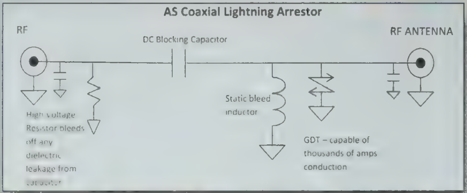
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Static bleed inductor
GDT – capable of thousands of amps conduction

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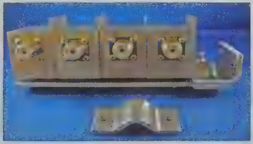
16 Terminal Cable Arrestor
Cable Arrestors



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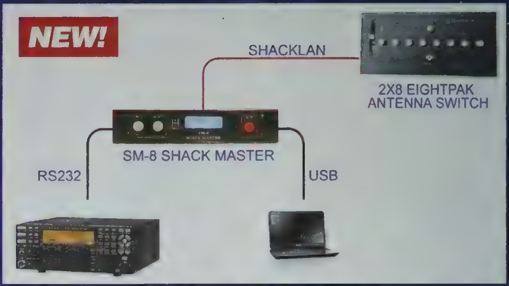
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2X8 EIGHTPAK ANTENNA SWITCH
SM-8 SHACK MASTER
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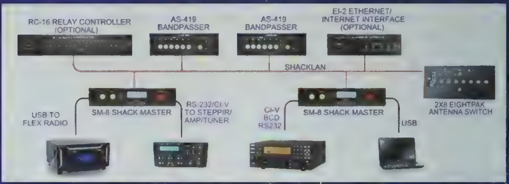
A more complex system could be a SO2R contest station as shown.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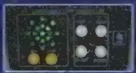

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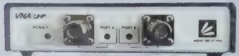

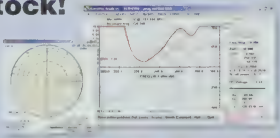

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Becky R. Schoenfeld, W1BXY, bschoenfeld@arrl.org

Member Spotlight

Matt Makaveli, KY4GPD

General-class licensee Matt Makaveli, KY4GPD, of Georgetown, Kentucky, has some unique ham radio bragging rights: he designed Kentucky's ham radio license plate. The process began a few years ago on a whim, when Matt decided to send then-Kentucky Lieutenant Governor Jenean Hampton, K5EIB (who served from 2015 – 2019), a ham radio license plate design.

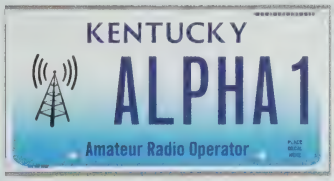
"I figured who better to understand…a license plate designed *by* a ham radio operator *for* ham radio operators?" Matt said. He modified an existing Kentucky ham radio plate to include an antenna, and sent it to Hampton, who expressed interest, as did Kentucky Section Manager Steve Morgan, W4NHO. The idea for the plate circulated briefly, then fell by the wayside until a few years later, when the state moved from a stamped plate to a printed plate — and was looking to refresh the design of the ham radio plate.

May the Best Design Win

Kentucky State Trooper Jack Hedges, KY4TPR, started a contest of sorts. He invited local hams to submit designs, which would be made public so hams could vote on them. Jack would then present the winning design at a Kentucky Transportation Cabinet (KYTC) meeting to see if it might meet with state approval.

Five designs were submitted to Jack's contest, and several hundred people voted. When all was said and done, Matt's design received 41% of the votes — much to his own surprise. "I thought I was gonna get clobbered," he said. "Some of the other designs were really nice."

True to his word, Jack, who is also the ARRL Kentucky Section State Government Liaison, brought Matt's design before the KYTC, who turned out to be interested. They asked for a few changes to the design, which Jack helped Matt implement over the course of a couple of months of discussion with the KYTC. "He made my design idea better," Matt said.



A mock-up of Matt's, KY4GPD, license plate design.

Ultimately, the design was finalized and went into production. The plate started being spotted on the streets in the spring of 2021. Matt is eager to get one for his own vehicle, which he says he'll do when his current plate expires.

A Community Focus

In the meantime, Matt keeps busy as a certified SKYWARN storm spotter, an Assistant Emergency Coordinator for Scott County, and net control for an ARES 2-meter net every Tuesday night. He's dabbled in FT8 at a friend's station, and his personal ham radio goal these days is to get set up to run it at home.

He's also the secretary of the Scott County Amateur Radio Emergency Services Club. "We're growing," Matt says of the club, who welcomed a brand-new ham to their ARRL Field Day operation earlier this year. "We have about 25 members, and we're growing, slowly but surely."

The club also engages in outreach activities, such as programming storm radios for the local community — a community where Matt's license plate is increasingly being seen.

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ARRL The National Association for Amateur Radio® in the United States: supports the awareness and growth of Amateur Radio worldwide; advocates for meaningful access to radio spectrum; strives for every member to get involved, get active, and get on the air; encourages radio experimentation and, through its members, advances radio technology and education; and organizes and trains volunteers to serve their communities by providing public service and emergency communications *(ARRL's Vision Statement, adopted in January 2016)*.

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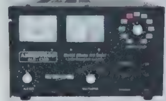

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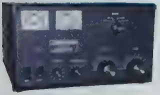

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$2199
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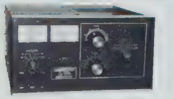

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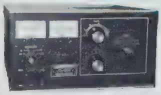

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Up Front

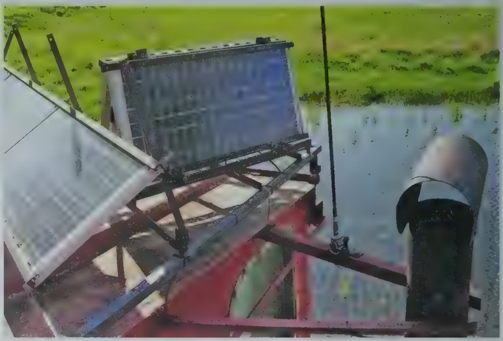
Operating from the Illinois Nature Preserve

Vince Koepke, NT9N, set up from an old-fashioned train caboose on the Santa Fe Nature Preserve in Hodgkins, Illinois. The grounds of the Santa Fe Prairie allow for various antenna configurations. Koepke operated with a mobile 3/8-24 mount fastened to the roof of the caboose, and the coax was run to the inside through the floor. He used a pulley system attached to nearby trees for hoisting a 25-foot, 20-meter dipole.

In December 2020, the Santa Fe Prairie was listed as an official Parks on the Air site (K-7839). The Prairie Caboose is open to the public from 10 AM to 2 PM on the weekends. The caboose is heated by the original stove, which is very important for Chicago winters. With advance notice, the Prairie allows for 24-hour ARRL Field Day operation.

Santa Fe
ATSF
999789

The Santa Fe Prairie and the train caboose, which operates as the visitor's center, is a good resource for testing antennas and operating special event stations. It has a mobile 3/8-24 mount fastened to the roof.



Santa Fe Prairie Volunteer Don Kinnally rewired the caboose to make it a usable visitor center for radio amateurs, adding a solar panel array and wind generator on the roof.

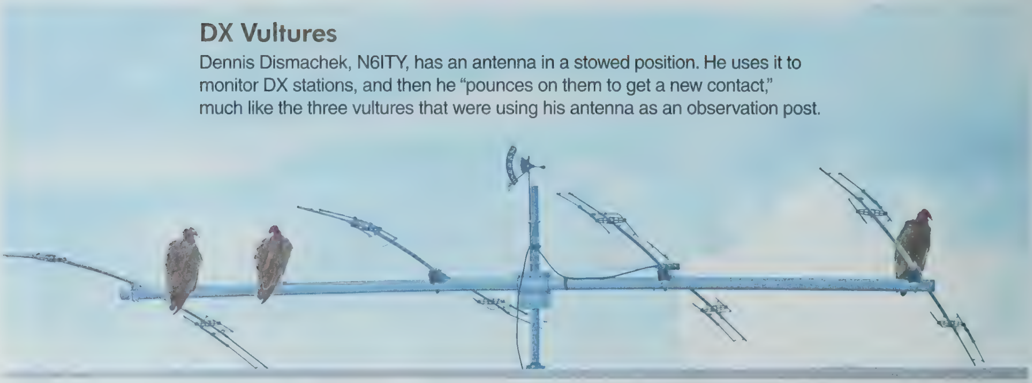
I THINK
THEREFORE
I HAM

A Fitting Gift

Charlie Maulick, WB2YZX, received this comfortable pillow as a thoughtful gift to put in his station. With the appropriate message, "I think, therefore I ham," Charlie's naps may be filled with visions of rigs, amps, and antennas.

DX Vultures

Dennis Dismachek, N6ITY, has an antenna in a stowed position. He uses it to monitor DX stations, and then he "pounces on them to get a new contact," much like the three vultures that were using his antenna as an observation post.



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Correspondence

Letters from Our Members

My 32-Foot Soda Can Antenna

The coffee can antenna on the cover of the August 2021 issue brought back memories of when I was a Novice operator. Newer hams may not be aware of the historical "beer can" antenna.

When I was 15 years old, my best friend, Chuck Goelz, WA3CEJ (SK), and I were too young to partake in the traditional source of cans for these antennas, so we used steel Mountain Dew cans instead. In my basement ham shack, I would solder together stacks of 10 – 15 cans. It took 73 cans to make the 32 feet needed for a 40-meter vertical antenna. Once we had enough, I soldered the stacks together in my backyard and set the antenna upright. A Mountain Dew plastic bottle was used for the base insulator and we used heavy string for guying. The antenna worked well, but was only up for about a week before some neighborhood kids knocked it down (we didn't expect the antenna to last long anyway).

A few years later, Chuck was in the US Army, stationed in Korea. Mountain Dew wasn't available near his Army base, so his mom wrote a letter to PepsiCo asking if they had a distributor near Chuck's address to ship him some. She also enclosed some photos of our soda can vertical antenna with her letter. A few weeks later she received a letter back, stating that a case of Mountain Dew was on its way to Chuck, courtesy of PepsiCo!

Don Stewart, WA3HGW
Pittsburgh, Pennsylvania

Radio on the Big Screen

I've been home more due to the COVID-19 pandemic and have been watching movies to pass the time. I recently watched the 1944 World War II movie short *Patrolling the Ether*, about amateur radio transmissions being ordered to cease on December 8, 1941 — the day after the attacks on Hawaii, the Philippines, Guam, Malaya, Taiwan, and Wake Island. The film was also reviewed in the May 1944 issue of *QST*.

The story follows a young ham who's visited by an FCC Radio Intelligence Division (RID) official, who informs him that ham radio communications are banned due to the impending war, but asks him to keep listening to the air waves for any suspicious activity. The young ham eventually joins the agency and helps track down Nazi agents transmitting from a cemetery and a moving taxi.

It's always fun watching films about our hobby!

Marvin Taylor, AE0EG
Omaha, Nebraska
Life Member

QST's New Advice Column

When it was announced that Dave Casler, KE0OG, would be writing the "Ask Dave" column in replacement of Joel Hallas', W1ZR, "The Doctor is In," I was skeptical. Because I've watched a few of Dave's videos on his YouTube channel, *Ham Radio Answers*, I knew he was knowledgeable, but I wasn't sure if he could fill the Doctor's shoes. However, after only a few columns, I've been proven wrong — Dave is doing a great job.

Although I'll miss Joel, I'm glad to flip to Dave's column each month when *QST* arrives in my mailbox.

Steve Hersey, K7OFG
Payson, Arizona

A Solution to Poor Field Day Propagation

As many 2021 ARRL Field Day participants recall, Saturday, June 26, had poor HF propagation (thankfully, Sunday was better). Our club, Kent Amateur Radio Society in Chestertown, Maryland, only made 16 contacts on the first day. Operating with the call K3ARS, our club had a plan in case the HF bands were dead: VHF on SSB. We had 6-meter and 2-meter stations set up with beams, hoping to make some extra contacts. We did make some, but not as many as I'd hoped.

This year was a perfect example of why I think clubs should consider having VHF (SSB and CW) stations for Field Day 2022. Beams for 2 and 6 meters aren't very large, are easy to set up and take down, and could provide another option to unreliable HF propagation. Although these bands can be unpredictable, they seem to regularly have sporadic openings. Having two VHF station setups can provide an opportunity for more participation (and maybe more points).

Field Day seems to mostly focus on HF, but thinking outside the box might pay off in points and fun. During the first VHF SSB contest I participated in, I was surprised to make contacts up to 350 miles away on 2 meters with a 15-element beam and 30 W of power.

If more clubs and stations add VHF to their operations, there will be more activity on those bands during the contest. That means more contacts and more fun for everyone. I hope to hear you on the VHF bands during Field Day 2022!

Chris Cote, KE5NJ
Smyrna, Delaware
Life Member

Send your letters to "Correspondence," ARRL, 225 Main St., Newington, CT 06111. You can also submit letters by fax at 860-594-0259, or via email to **letters@arrl.org**. We read every letter received, but we can only publish a few each month. We reserve the right to edit your letter for clarity, and to fit the available page space. Letters published in "Correspondence" may also appear in other ARRL media. The publishers of *QST* assume no responsibility for statements made by correspondents.

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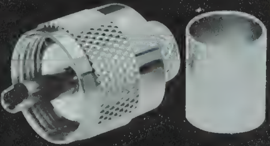

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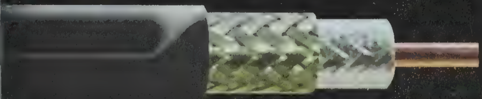

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PAC	MTN	CENT	EAST	UTC	MON	TUE	WED	THU	FRI
6 AM	7 AM	8 AM	9 AM	1400		FAST CODE	SLOW CODE	FAST CODE	SLOW CODE
7 AM- 1 PM	8 AM- 2 PM	9 AM- 3 PM	10 AM- 4 PM	1500-1700 1800-2045	VISITING OPERATOR TIME (12 PM-1 PM CLOSED FOR LUNCH)				
1 PM	2 PM	3 PM	4 PM	2100	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE
2 PM	3 PM	4 PM	5 PM	2200	CODE BULLETIN				
3 PM	4 PM	5 PM	6 PM	2300	DIGITAL BULLETIN				
4 PM	5 PM	6 PM	7 PM	0000	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE
5 PM	6 PM	7 PM	8 PM	0100	CODE BULLETIN				
6 PM	7 PM	8 PM	9 PM	0200	DIGITAL BULLETIN				
6^{45} PM	7^{45} PM	8^{45} PM	9^{45} PM	0245	VOICE BULLETIN				
7 PM	8 PM	9 PM	10 PM	0300	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE
8 PM	9 PM	10 PM	11 PM	0400	CODE BULLETIN				

W1AW's schedule is at the same local time throughout the year. From the second Sunday in March to the first Sunday in November, UTC = Eastern US time + 4 hours. For the rest of the year, UTC = Eastern US time + 5 hours.

♦ Morse code transmissions: Frequencies are 1.8025, 3.5815, 7.0475, 14.0475, 18.0975, 21.0675, 28.0675, 50.350, and 147.555 MHz.

Slow Code = practice sent at 5, 7½, 10, 13, and 15 WPM.

Fast Code = practice sent at 35, 30, 25, 20, 15, 13, and 10 WPM.

Code bulletins are sent at 18 WPM.

For more information, visit us at
www.arrl.org/w1aw

♦ W1AW Qualifying Runs are sent on the same frequencies as the Morse code transmissions. West Coast qualifying runs are transmitted by various West Coast stations on CW frequencies that are normally used by W1AW, in addition to 3590 kHz, at various times. Underline 1 minute of the highest speed you copied certify that your copy was made without aid, and send it to ARRL for grading. Please include your name, call sign (if any), and complete mailing address. Fees: $10 for a certificate, $7.50 for endorsements.

♦ Digital transmissions: Frequencies are 3.5975, 7.095, 14.095, 18.1025, 21.095, 28.095, 50.350, and 147.555 MHz.

Bulletins are sent using 45.45-baud Baudot, PSK31 in BPSK mode, and MFSK16 on a daily revolving schedule.

Keplerian elements for many amateur satellites will be sent on the regular digital frequencies on Tuesdays and Fridays at 6:30 PM Eastern time using Baudot and PSK31.

♦ Voice transmissions: Frequencies are 1.855, 3.99, 7.29, 14.29, 18.16, 21.39, 28.59, 50.350, and 147.555 MHz. Voice transmissions on 7.290 MHz are in AM double sideband, full carrier.

♦ Notes: On Fridays, UTC, a DX bulletin replaces the regular bulletins. W1AW is open to visitors 10 AM to noon and 1 PM to 3:45 PM Monday through Friday. FCC-licensed amateurs may operate the station during that time. Be sure to bring a reference copy of your current FCC amateur license. In a communication emergency, monitor W1AW for special bulletins as follows: voice on the hour, teleprinter at 15 minutes past the hour, and CW on the half hour.

W1AW code practice and CW/digital/phone bulletin transmission audio is also available real-time via the *EchoLink Conference Server* W1AWBDCT. The conference server runs concurrently with the regularly scheduled station transmissions. The W1AW Qualifying Run texts can also be copied via the EchoLink Conference Server.

During 2021, Headquarters and W1AW are closed on New Year's Day (January 1), Presidents Day (February 15), Memorial Day (May 31), Independence Day (observed July 5), Labor Day (September 6), Veterans Day (November 11), Thanksgiving and the following day (November 25 and 26), and Christmas Eve (December 24).

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The CW Game

Learning and practicing
Morse code can be a fun activity.

Robert Anding, AA5OY

The CW Game is a code practice system based on a Morse code typewriter that uses an iambic Morse key as the input, along with a CW typing game program. After I completed an earlier Morse code CW typewriter project, I practiced Morse code using the CW typewriter, with my computer's notepad program as a display.

How It Works

To liven things up, I wrote a tiny proof-of-concept command-line CW practice program that ran on both my PC and Linux computers. This program placed a randomly chosen letter, number, or word on the screen and waited for me to send it using the CW typewriter. I could use the backspace key to remove my mistakes and then enter the correct character. The practice characters — which could be a letter, number, word, or sentence — were stored in a text file, one entry per line. The ability to create my own files allowed for a focused practice of problem letters or numbers, or difficult words. I went on to create files containing letters, numbers, state abbreviations, common words, QSO terms, call signs, and more. I saved each file in the same directory as the program, and I used these as part of my daily CW practice.

What made things more exciting were some online typing program games, which took the drudgery out of sending practice CW. They challenged me to send faster as the game's speed slowly increased. However, there was a limiting factor. The groups of letters, numbers, and common words were hard-coded into program and couldn't be changed. In trying to solve this dilemma, I created *The CW Game*.

The CW typewriter uses an iambic key that acts as the computer keyboard. I based my project on the Arduino Leonardo because it can mimic the keyboard and mouse. I added a small circuit consisting of an iambic key input jack, speaker output jack, rig keyer output, WPM potentiometer, space switch, and the Leonardo USB port for communications with the PC (see Figure 1).

Improvements

To keep the focus on the CW typewriter, I added a few prosign characters: $\overline{\text{AA}}$ (start new line) sends a return character; $\overline{\text{BT}}$ (start new section) prints a line feed and adds an =, and the $\overline{\text{BK}}$ (break) prints an *. With these added prosigns, my practice ran more smoothly. At this point, the proof-of-concept program needed some improvements.

First, I eliminated the parts of my earlier Arduino CW typewriter program not needed for gaming. Using the keyboard emulation made it compatible with different operating systems. Second, I wrote a simple CW game program that used text files as the input, like my little CW practice program did. The ability to make up text files was a nice feature that I wanted to keep.

I wanted to make the code open source, hoping others might add to it and allow it to grow. I wrote the code in *Python*, because it has a big gaming community, and I thought some hams may want to create more adventurous games for CW practice. Additionally, I wanted the program to work on the three commonly used operating system platforms: PC, Mac, and Linux.

> *"Online typing games took the drudgery out of sending practice CW."*

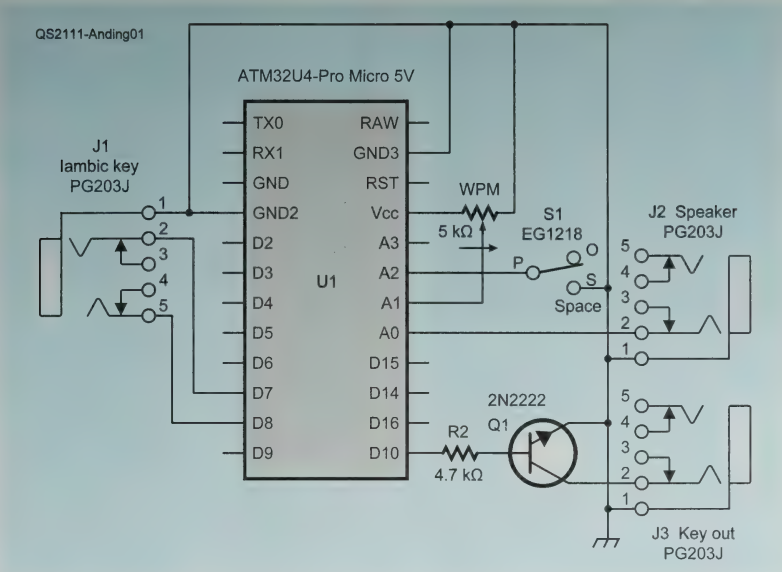

Figure 1 — The partial schematic diagram shows how the added components connect to the Arduino microchip.

Hardware: Arduino Leonardo and the CW Typewriter Sketch

Choosing the Arduino Leonardo made communicating with the computer USB port easy. I chose the ATmega32u4 microchip, 16 MHz, 5 V Micro Pro version, which can act as a keyboard or mouse. The Arduino Leonard sketch is available at **www.arrl.org/qst-in-depth**.

The small circuit attached to the Leonardo uses a simple design. Inputs are the dit (Pin 7), dah (Pin 8), and space (Pin A2); the space switch adds a word space when working with sentences, pangrams, and so on. The WPM (Pin A1); and the speed potentiometer adjusts the WPM speed of the keyer. Outputs are KeyPin (Pin 10) for the transceiver's key and a speaker pin for sidetone. The sidetone frequency code line *int sideTone = 600* in *Sketch_CW_Kybd_8-10-21.ino* is currently set for 600 Hz (suggested range is 500 to 900 Hz). The speaker output uses the Arduino Pin A0. I recommend using an amplified speaker.

You can use your transceiver as a speaker by hooking up the Arduino key out pin to the rig. Do this with caution — the KeyPin output is logic level, so check your transceiver's specifications. I also recommend that you use a 4.7 kΩ resistor along with an open collect transistor. The transistor on KeyPin output will transmit a logic ground when active.

The Arduino program contains a letter array used to convert Morse code to ASCII code. As each CW character is sent with the iambic key, each dit equals a 0 and each dah equals a 1. The 1s and 0s are collected until an end of character is detected. The character's code is compared to the letter array, and if a match is detected, it is converted to the ASCII character and sent via the USB port to the keyboard input of the computer. The letter array consists of letters, numbers, punctuation marks, and a few prosign characters. Additional Morse code characters can be defined to make additional keyboard characters. Because prosigns are used in Morse code, they make sense for this application.

Regarding keyboard emulation, whatever is sent using the iambic key is transmitted to the active computer window. Be careful, because you can inadvertently add characters to a program on your computer. Remember to click the window to give it focus, so it receives the CW typewriter output.

> *"The Arduino program contains a letter array used to convert Morse code to ASCII code."*

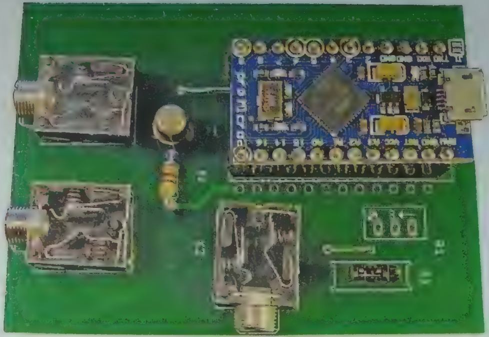

Figure 2 — The CW Typewriter board uses very few components.

The circuit (see Figure 1) consists of accessible parts and can easily be built using a prototyping board. I have designed a shield PCB for the Leonardo and a PCB for the Pro Micro version of the Leonardo (see Figure 2). If you are interested in getting a PCB for this project, contact me about price and availability.

Software

The software files are in a folder on the *QST* in Depth web page. I wrote the CW Game program in *Python 3* using the additional features from the Pygame module. *Python 2.7* comes loaded on many Mac and Linux operating systems, so make sure that you upgrade to *Python 3*. For Windows, download it from the Python website at **www.python.org/downloads**.

After *Python 3* is loaded on the computer, install the Pygame module. Pygame makes it possible to build and run Pygame programs. Instructions are at **www.pygame.org/wiki/gettingstarted**. The OS will detect files with the .py extension. Simply clicking on the *Python* file *CW_typerFINAL.py* will load the game. The CW Game program starts with a splash screen with an entry box outlined in red. Click on the entry box, type the name of the file with its extension (LETTERS.TXT), hit return, and the game begins. Keeping the text files in the same directory is a good practice and eliminates the need for adding a path to the file name.

There are several functions within the program. The splash screen asks for a file name. After hitting return, it is sent to the **NEW_WORD** function, which checks for the file. If the file is found, it opens the file and copies its contents to a list. The **PLAY_GAME** function opens the game's screen, displays a random line, and moves it down the screen. The game starts slowly, and over time, it increases its pace down the screen. If the line contains more than one character, the game highlights the player's correctly entered characters in red. Otherwise, if the player misses a character, the player's answer is erased, and the player starts the line over. If it reaches the bottom of the screen, the game displays a Game Over screen with the score, and the game has ended.

The splash screen also lists the **ESC** and the **F1** keys. Hitting the **ESC** key will quit the game, while the **F1** key starts the game over by resetting the speed to slow and the score to zero. If you're getting too close to the bottom, hit the **F1** key and start over.

If a line consists of only one entry (letter, number, or a single word), the CW typewriter's space switch can be left in the **OFF** position. When working with a phrase containing spaces, turn the space switch **ON**. With the space switch **ON**, the CW typewriter detects an inter-word pause and automatically adds a space. There is meaning in the timing of spaces, so working on spacing is important to the flow of information. This is a simple game, but it can be made as complex as you want.

If you are not inclined to load *Python 3* and Pygame on your system, try the online typing lessons and games at **www.typing.com/student/lessons** and **www.typing.com/student/games**.

Over the years, CW has proved to be a valuable mode that needs continuous practice to maintain and improve CW skills. I hope you'll find it as helpful and fun as I have.

Robert Anding, AA5OY, has been a licensed amateur radio operator for 33 years. He retired from broadcast engineering after 38 years. He has a Commercial General Radio Operator License (previously, First-Class Radiotelephone License). Bob earned a Bachelor's degree in computer science from Loyola University New Orleans. He enjoys operating QRP, programming, and ham radio projects. Some are posted on his web page **www.aa5oy.com**. You can reach Bob at **aa5oy@arrl.net**.

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An Optimized Inverted L for 160 & 80 Meters

Dual-band use for your 160-meter antenna.

George Cooley, NG7A

An inverted-L antenna, popular on 160 and 80 meters, is optimized by the horizontal part of the antenna, providing a mostly vertically polarized signal. The inverted L described here is a variation of Don Toman's, K2KQ, Double L bent vertical (described in his article "Revisiting the Double L," from the June 2011 issue of the Yankee Clipper Contest Club's newsletter). This inverted L increases the radiating current while canceling the horizontal polarization components.

Design

The Double L's upper arm is replaced with a 160-meter loading coil and a 10-foot section of wire. The radiating vertical element is 0.166 λ (85 feet) long. On 80 meters, the coil acts as an RF choke, and the vertical wire below the coil provides a 0.333 λ radiator. The vertical wire is held up by a 22-foot pole and then slants toward an 80-foot tower 45 feet away. Two 0.166 λ lower wires, one for 160 meters (85 feet) and the other for 80 meters (45 feet), run 6 – 8 feet above the ground under the slanted wire. These cancel some of the horizontally polarized components and create an off-center feed. A 2:1 balun matches the antenna's 100 Ω feed-point impedance to 50 Ω. A ground screen provides shielding of the E field to the ground, but it is not physically connected to the antenna. To save wire, the ground screen can also be made of fencing or zig-zag wires. As long as the aperture (the greatest opening) is less than 3 feet, the shielding effectiveness will be the same as with radials (see Figures 1 and 2).

Theory

Most of a dipole's current that produces the radiated field is contained in the middle third of the dipole — between 0.166 and 0.333 λ from the ends (seen by making a half-wave dipole from a string of incandescent lights). Therefore, the ends can be bent horizontally or replaced by coils without much consequence. The Double L works the same way in that the maximum current is in the middle of the vertical wire, which is well above ground. The relatively smaller currents in the horizontal upper and lower wires cancel, thus leaving the antenna predominantly vertically polarized.

Calculations

It is easiest to feed a dipole or half-wave vertical in the middle with 50 Ω coax. However, a dipole's feed-point impedance varies as a sinusoidal function from the distance to its ends, with the lowest impedance in the center, and near infinite impedance at the ends.

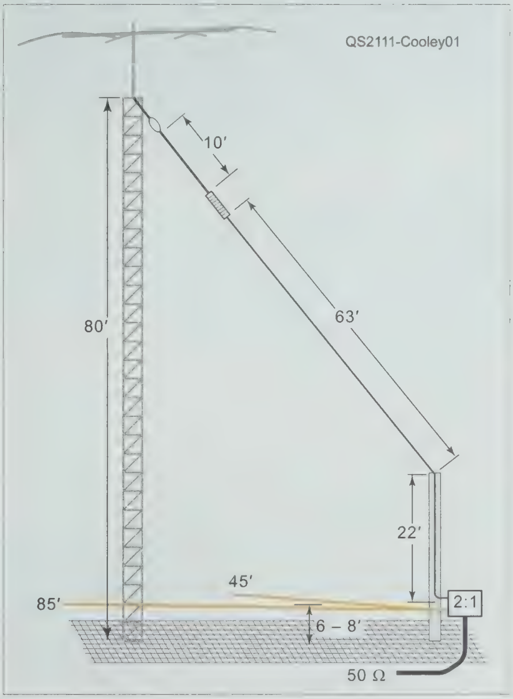


Figure 1 — The optimized inverted-L antenna dimensions.

According to John D. Kraus's, W8JK, 1988 *Antennas* book, the feed-point impedance is a function of location, and it can be calculated as follows:

$Z = Z_0 / (\sin(360 \times X)^2)$, where:

Z_0 is the feed-point impedance at the center (~72 Ω), and

X = position in wavelengths from the left side of the antenna (0 to 0.5 λ).

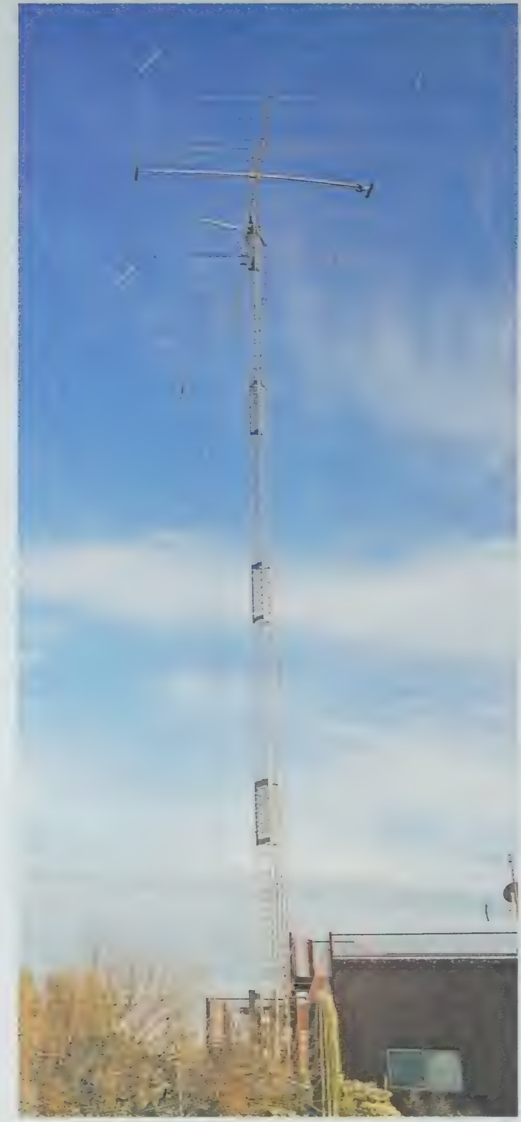


Figure 2 — The optimized inverted-L antenna.

160-Meter Wire Lengths

A full-wave wire at 1.830 MHz is 511 feet. One third of a dipole (0.166 λ) is 85 feet. At this length, the feed point impedance is about 96 Ω with a lower horizontal wire cut for about 85 feet. A coil is inserted at the end of 85 feet of wire, and 10 feet from the end of the line. I calculated that the coil inductance needed to be about 390 µH at 1.83 MHz to resonate the antenna on 160 meters.

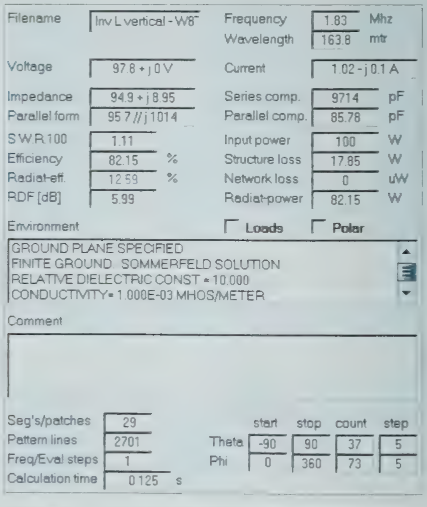
80-Meter Wire Lengths

A full-wave wire at 3.539 MHz is 264.7 feet. The ideal length of the upper wire is 88 feet (0.333 λ), and 44 feet (0.166 λ) is the desired length of the lower horizontal wire. Because the actual upper wire is 85 feet, the lower horizontal wire can be lengthened to 47 feet and cut to resonance.

NEC Simulations

The structure was simulated using the Numerical Electromagnetics Code (NEC). Wire from the base to the coil was 85 feet. Wire from the coil to the upper end was 10 feet. The lower wire was 1 foot off the ground and 82 feet long. NEC simulated a dry, sandy soil that is characteristic of the desert southwest.

The simulation showed that my initial hand-calculated coil impedance of 4,492 Ω (390 µH) was too high, resulting in a higher feed-point impedance. It also forced the current too high into the upper part of the wire with almost no current in the lower part of the wire. The resulting radiation pattern was also



Filename Inv L vertical - W8
Frequency 1.83 Mhz
Wavelength 163.8 mtr
Voltage 97.8 + j 0 V
Current 1.02 - j 0.1 A
Impedance 94.9 + j 8.95
Parallel form 95.7 // j 1014
Series comp. 9714 pF
Parallel comp. 85.78 pF
S.W.R.100 1.11
Efficiency 82.15 %
Radiat-eff. 12.59 %
RDF [dB] 5.99
Input power 100 W
Structure loss 17.85 W
Network loss 0 uW
Radiat-power 82.15 W
Environment
☐ Loads
☐ Polar

GROUND PLANE SPECIFIED
FINITE GROUND. SOMMERFELD SOLUTION
RELATIVE DIELECTRIC CONST = 10.000
CONDUCTIVITY= 1.000E-03 MHOS/METER

Comment

Seg's/patches 29
Pattern lines 2701
Freq/Eval steps 1
Calculation time 0.125 s

	start	stop	count	step
Theta	-90	90	37	5
Phi	0	360	73	5

Figure 3 — The NEC-tabulated data.

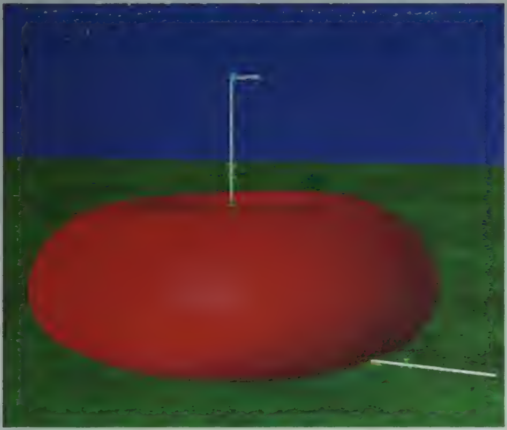


Figure 4 — The NEC-simulated radiation pattern.

degraded. Reducing the coil impedance to 3,894.5 Ω (339 µH) maximized the current in the middle (vertical) part of the wire. The small remaining currents were taken up by the upper coil/wire, as well as the lower, tuned wire.

As NEC showed a feed-point impedance of 99 Ω, a 2:1 balun was used to transform this to 50 Ω. The resulting radiation pattern is also nearly uniform. Bending the upper part of the wire will result in a little skewing of the pattern, as well as changing the feed-point impedance. The model showed that the feed-point impedance can be adjusted by varying the length of the lower wire. Figure 3 shows the tabulated NEC data, and Figure 4 shows the radiation pattern.

Building the Coil

For 339 µH, Wheeler's formula predicted 150 turns of 20 AWG close-wound along 8.4 inches on a 2.4-inch outside diameter × 11-inch long PVC pipe (2-inch PVC has an outside diameter of 2.4 inches). In reality, it took 158.5 turns to get 339 µH on the analyzer. When tuning the actual antenna, 13 turns were taken off by soldering a jumper on the coil to bring the antenna into resonance on 1.830 MHz. The lower wire was then tuned for the lowest SWR. Next, the 80-meter lower wire was added and trimmed for the lowest SWR on 3.530 MHz. The final coil, shown in Figure 5, was brushed with PVC cement to stabilize the turns.

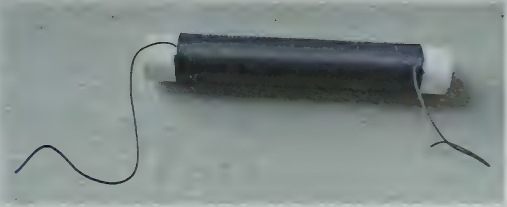


Figure 5 — The finished 339 µH inductor.

Results

The antenna has less than a 1.5:1 SWR on the CW portions of 80 and 160 meters, and it takes 1.5 kW on both bands. The impedance is more stable compared to the ¼-wave inverted-**L** antenna and does not vary between wet and dry conditions.

Finally, I want to give a special thanks to Tom, W8TK, and Larry, KE2VB, for the many hours of cutting, measuring, and remeasuring that went into optimizing this antenna.

All photos by the author.

ARRL Life Member George Cooley, NG7A, has been a ham since an early age. A licensed Airline Transport Pilot and Electrical Engineer, he has developed many aircraft communications radios, navigation systems, transponders, and datalinks. A Senior RF Engineering Manager for Collins, George enjoys flying, hiking (SOTA), bicycling, and improving reception of weak signals through simple homebrewed antenna systems. He maintains **www.ng7a.com** and can be reached at **george@ng7a.com**.

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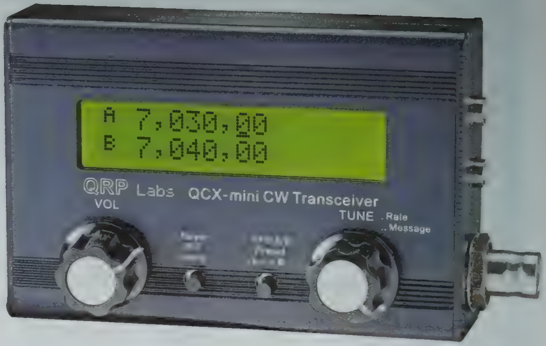
Strays

I would like to get in touch with anyone that has vintage Motorola two-way radios, working or nonworking. I'm looking for a Mitrek base station, preferably with manuals. — *ARRL Life Member Rich Ballieu, WB0TML, 6001 Horseshoe Bend, Mandan, ND 58554.*

Product Review

QRP Labs QCX-mini CW Transceiver Kit



Reviewed by Paul Danzer, N1II
n1ii@arrl.net

You can fit this single-band CW transceiver in your shirt pocket, but it can do much of what a full-size home-station radio can do. The QCX-mini is the latest in a series of QRP transceivers from QRP Labs. The radio delivers about 5 W RF output with a 13.8 V power supply, and it will operate from 7 to 14 V. On receive, it draws a battery-friendly 85 mA, helpful for portable operation. An optional case, shown in the title photograph, is available.

The QCX-mini includes two VFOs with adjustable tuning rate, receiver incremental tuning (RIT), and 16 frequency memories. There's a CW memory keyer with practice and straight key modes, along with a CW decoder. CW offset and sidetone are adjustable. The display can show an S-meter, battery voltage, and the current time. The QCX-mini can also be set up to transmit WSPR (Weak Signal Propagation Reporter) beacons. To see the extent of this small radio's capabilities, check out the detailed documentation on the QRP Labs website.

We reviewed the original QCX transceiver in the August 2019 issue of *QST*. The most notable change from the original transceiver is the QCX-mini's smaller size. The QCX-mini in its optional case measures approximately 3.7 × 2.5 ×1 inches excluding protrusions, and it weighs 7 ounces.

Overview

The QCX-mini is available as a kit or assembled and tested. It can be built for 80, 60, 40, 30, 20, or 17 meters, and the features are the same for all versions. The front panel has a 16 × 2 (16 character by 2 line) LCD, two knobs, and two pushbuttons. Look for the *Cheat Sheet* page in the assembly or operation manual for details on using these controls.

The left knob (**VOL**) is the receiver volume control. The markings on the front panel help with using the two pushbuttons. Above the left-hand pushbutton is a single dot with the word **KEYER**. Push the button once and you can select the keyer speed by rotating the **TUNE** control. Other keyer choices are available in a menu. Below this **KEYER** label is the **RIT** label with two dots. Push the button twice, and you can select receiver incremental tuning (RIT) settings. Finally, the bottom **MENU** label has a dash next to it. Give the button a long press to open up the nine-section menu described in the *Cheat Sheet*.

One press of the other pushbutton selects the VFO mode (VFO A, VFO B, or split-frequency operation). Two presses, and you can save or recall a VFO memory. A long push transfers information from one VFO to the other.

The right-hand **TUNE** knob is a rotary encoder with a pushbutton switch. It is used primarily for frequency tuning, settings, and menu selections. A single press of the **TUNE** button changes the tuning rate (1 kHz, 500 Hz, 100 Hz, or 10 Hz). A double or long press is used to select and send a stored CW message from memory. With these three controls, many common operating choices may be made without going into the detailed menus.

Bottom Line

The QCX-mini from QRP Labs is a popular, tiny 5 W CW transceiver kit that can be built for 80, 60, 40, 30, 20, or 17 meters. Construction requires mounting through-hole components, and the instruction manual is excellent.

Circuit Highlights

The construction manual has a full schematic and an extensive explanation of the circuit operation. The QCX-mini design is similar to the original QCX. It's based on a preprogrammed ATmega328 microcontroller, along with an Si5351A phase locked loop. The Si5351A is controlled by a 27 MHz crystal, and its outputs are used in various ways.

On transmit, the microcontroller generates a signal, which is then shaped for the CW waveform and sent through a driver to a set of three transistors operating in class E. Finally this output is routed through a seven-element low-pass filter. The final three amplifier transistors and the driver are mounted close to each other on the circuit board. A flat washer presses all four transistors against the PC board ground plane, which serves as the heatsink.

On receive, the input signals are routed through the low-pass filter to a quadrature sampling detector, also called a Tayloe detector. Following the detector, two operational amplifiers subtract the phased outputs (I and Q), and then they are combined to form a single output. Next in the chain is a 200 Hz CW filter, followed by the audio amplifier. Enough audio power is available to drive a set of headphones, but not quite enough for a speaker.

Building and Alignment

The QCX-mini assembly manual runs about 120 pages and is available as a PDF on the QRP Labs website. In addition to step-by-step construction details, the manual includes sections on alignment, initial setup, circuit design, and troubleshooting. The manual is exceptionally complete and includes many high-quality illustrations throughout.

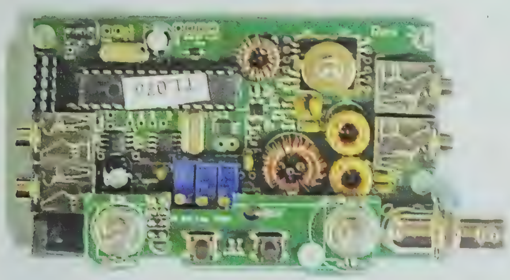


Figure 1 — The main circuit board carries most of the components for the receiver and transmitter sections. The microcontroller (white label) is at the upper left. T1 is the larger toroid near the center, and the socket that connects to the display board is in the upper left. The driver and final amplifier transistors are at the upper right, under the washer.

The QCX-mini is a sandwich of two printed circuit boards. The main board, shown in Figure 1, comes with many SMD (surface-mounted device) components already installed. The builder only has to add standard through-hole parts. The parts you must insert yourself have almost one page devoted to each component. Occasionally, the instructions for inserting a component run over to a second page, so it's a good idea to check the next page for additional information. The board is tightly packed, so take your time building it.

Large, clear, color photos and drawings make the construction task easier. The text notes that additional heat from your soldering iron may be needed occasionally because connections are made to the hidden ground plane. When it appeared more heat was needed, I left the soldering iron on the joint a bit longer.

Five toroids have to be wound. T1, the input transformer, is critical and a bit challenging (the manual calls it "the only really tricky piece of assembly"). The input signal is routed to five turns on T1, wound on a T50-2 toroid about the size of a dime. A multi-turn winding on the same core is resonant with a variable capacitor for the band selected. Two other five-turn windings have to be phased correctly and as identical as possible. During alignment, three variable resistors compensate for slight differences between these windings. The manual includes detailed instructions and several illustrations to help you build T1.

The manual recommends burning the insulation off the enameled wire used to wind the toroids. I followed this procedure, but during testing, the ARRL Lab discovered that in some cases, enough insulation was left to make poor soldered connections. It's probably best to scrape off the insulation first.

When the assembly of each board is completed, the two boards plug together as a sandwich with the display board on top (see Figure 2). I had a minor issue

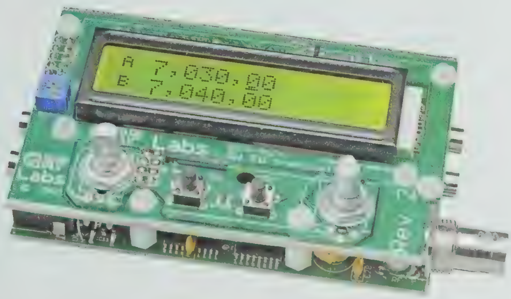


Figure 2 — The display/control PC board completes the sandwich, with the main board on the bottom.

assembling the unit in its optional enclosure, but after re-reading the instructions, I realized that the case would go on only one way. The complete alignment procedure is brief and can be accomplished quickly. If for some reason you are not happy with the result, you can run through the alignment procedure again.

The QCX-mini has built-in troubleshooting capability, and the manual includes approximately 40 pages of circuit and troubleshooting information. As with most QRP transceivers and kits, there's an active online group with other builders willing to help (see **groups.io/g/QRPLabs**).

A nice added benefit of the QCX series transceivers is built-in test equipment. Although the test equipment is designed primarily to allow alignment and troubleshooting of the QCX-mini, the manual shows PC board connections for making external measurements. The test equipment set consists of a digital voltmeter (0 – 20 V dc), an RF power meter (0 – 5 W), a frequency counter (0 – 8 MHz), and a signal generator (3.5 kHz – 200 MHz).

Using the QCX-mini

The left side of the radio has a 2.1-millimeter coaxial dc power jack (cable and connector not supplied). There's a 3.5-millimeter phone jack for a keyer paddle, and another for stereo headphones. The right side panel has a BNC connector for the antenna feed line, 3.5-millimeter phone jacks for PTT output (for controlling an external amplifier or other device), and a computer-aided transceiver (CAT). I didn't use the CAT feature, but the manual gives instructions for making a cable to interface the transceiver with a PC serial port or USB-to-serial converter. The QCX-mini is compatible with the Kenwood TS-480S command set found in most logging software.

Table 1
QRP Labs QCX-mini, firmware version 1.07

Manufacturer's Specifications	**Measured in the ARRL Lab**
Frequency coverage: 40-meter amateur band.	Receive and transmit: As specified.*
Power requirements: 7 V dc minimum to 14 V dc maximum.	At 13.8 V dc: Receive, 85 mA (backlight on); 66 mA (backlight off). Transmit, 682 mA.
Modes of operation: CW. In beacon mode, CW, FSK CW, and WSPR.	As specified.
Receiver	**Receiver Dynamic Testing**
Sensitivity: Not specified.	Noise floor (MDS): –130 dBm at 7 MHz.
Noise figure: Not specified.	7 MHz, 21 dB.
Blocking gain compression dynamic range: Not specified.	Blocking gain compression dynamic range: 20 kHz offset, 126 dB; 5/2 kHz offset, 116/110 dB.
Reciprocal mixing dynamic range: Not specified.	Not measured. Low-noise 7 MHz oscillator not available.

ARRL Lab Two-Tone IMD Testing

Band	*Spacing*	*Measured IMD Level*	*Measured Input Level*	*IMD DR*
7 MHz	20 kHz	–130 dBm	–31 dBm	99 dB
		–97 dBm	–18 dBm	
		–50 dBm	0 dBm	
7 MHz	5 kHz	–130 dBm	–46 dBm	84 dB
		–97 dBm	–29 dBm	
7 MHz	2 kHz	–130 dBm	–52 dBm	78 dB
		–97 dBm	–38 dBm	

Second-order intercept point: Not specified.	14 MHz, +53 dBm.
IF/audio response: Not specified.	Range at –6 dB points: 605 – 854 Hz (249 Hz).
Receive processing delay time: Not specified.	4 ms.
Transmitter	**Transmitter Dynamic Testing**
Power output: Up to 5 W, depending on supply voltage.	0.4 W at 7 V dc; 2.3 W at 10 V dc; 3.5 W at 12 V dc; 4.9 W at 14 V dc.
Spurious-signal and harmonic suppression: >50 dB.	49 dB. (See Figure A.) Complies with FCC emission standards.
CW keyer speed range: Not specified.	1 to 99 WPM, iambic A and B.
CW keying characteristics: Not specified.	See Figures B and C.
Transmit-receive turnaround time: Not specified.	S-9 signal, 23 ms (full-break-in); 570 ms (semi-break-in).
Transmit phase noise: Not specified.	See Figure D.

Size (height, width, depth): 2.5 × 3.7 × 1 inches, excluding protrusions. Weight, 7 ounces.

Second-order intercept point was determined using S-5 reference.

*The QCX-mini can be built for 80, 60, 40, 30, 20, or 17 meters. The 40-meter version was tested. Transmitter is capable of transmitting outside of the 40-meter band.

When I first turned on the radio, it was ready to get on the air with CW. All I had to do was select CW speed and reduce the sidetone volume, because I was testing with an external audio amplifier and speaker connected to the headphone output.

In addition to the assembly manual, the QRP Labs website offers a 52-page downloadable QCX operating manual. The radio has a lot of features, and it's well worth the time to read through this document. I found the *Cheat Sheet* near the end to be a helpful summary of the

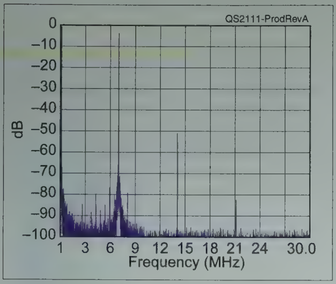


Figure A — Spectral display of the QCX-mini transmitter output. Power output is 5 W on the 7 MHz band. This plot shows the output spectrum from 0 to 30 MHz. The second harmonic is down 49 dB from the carrier, and the third harmonic is down 80 dB. The vertical scale is 10 dB per division.

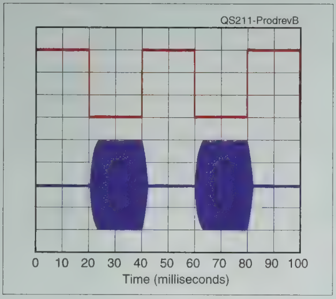


Figure B — CW keying waveform for the QCX-mini showing the first two dits in full-break-in (QSK) mode using external keying. Equivalent keying speed is 60 WPM. The upper trace is the actual key closure; the lower trace is the RF envelope. Horizontal divisions are 10 ms. The transceiver was being operated at 5 W output on the 7 MHz band. Rise time is 2.1 ms and fall time is 1.8 ms. First dit: on delay, 1.1 ms; off delay, 1.7 ms. Second dit: on delay, 0.8 ms; off delay, 1.6 ms.

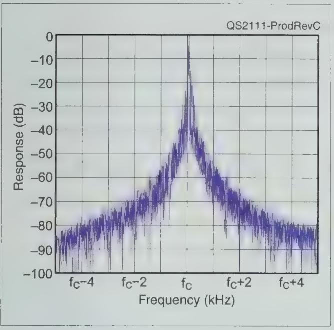


Figure C — Spectral display of the QCX-mini transmitter during keying sideband testing. Equivalent keying speed is 60 WPM using external keying. Spectrum analyzer resolution bandwidth is 10 Hz, and the sweep time is 30 seconds. The transmitter was being operated at 5 W PEP output on the 7 MHz band, and this plot shows the transmitter output ±5 kHz from the carrier. The reference level is 0 dBc, and the vertical scale is in dB.

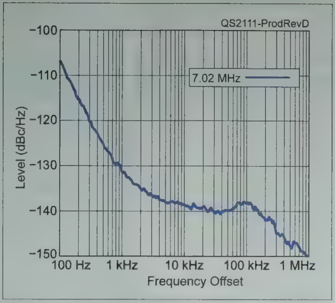
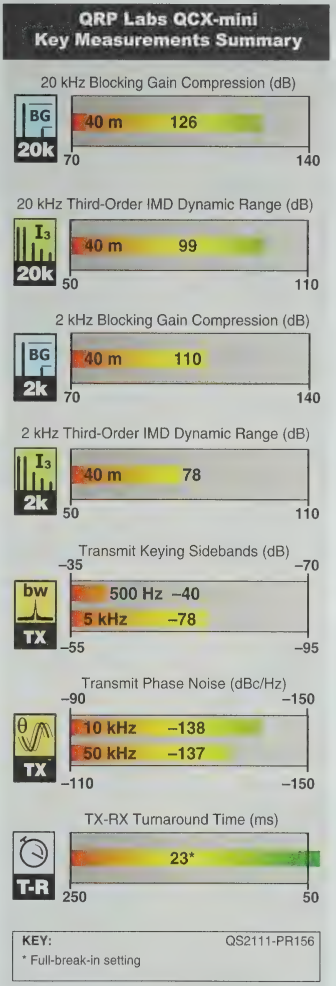


Figure D — Spectral display of the QCX-mini transmitter output during phase-noise testing. Power output is 5 W on the 7 MHz band. The carrier, off the left edge of the plot, is not shown. This plot shows phase noise 100 Hz to 1 MHz from the carrier. The reference level is −100 dBc/Hz, and the vertical scale is 10 dB per division.



menu items and controls. Once you have selected your default settings, you can save most of them from the configuration menu.

On the Air

As with any 5 W transceiver, your on-air results will depend somewhat on your antenna and band conditions. I was able to make contacts on 40-meter CW, mostly in the evening, without telling anyone that I was using just 5 W. My antenna is a fairly low 80-meter dipole fed with 10 feet of coax and then through a balun to ladder line to the dipole. A small tuner provides the needed match.

The 200 Hz CW filter seemed to work well, and with the speaker volume turned up, I did not hear noticeable ringing. The QCX-mini can operate in QSK (full break-in) or semi-break-in via a menu choice. The solid-state transmit-receive switching is silent.

Setting up the WSPR beacon was somewhat tedious, but it worked fine once I finished the configuration. If you plan to do a lot of WSPR operation, check out the optional QRP Labs QLG2 GPS module for time and frequency discipline and automatic setting of the Maidenhead grid locator.

In Summary

The QCX-mini QRP CW transceiver works well and offers many useful features. It makes extensive use of menus, so keep a copy of the *Cheat Sheet* from the manual handy. Kit construction is not too hard, although building the T1 input transformer can be challenging.

Manufacturer: QRP Labs, Mugla, Turkey; **www.qrp-labs.com**. Price: QCX-mini kit (specify band), $55. Built and tested, $100. Aluminum enclosure, $20. QLG2-SE GPS module, $20. TCXO module, $8.25. Shipping to the US is around $12 via FedEx and typically takes about a week.

SOTABEAMS External DSP Audio Filter

Reviewed by Steve Ford, WB8IMY
wb8imy@arrl.net

In the age of software-defined transceivers, you may think no one needs an external audio filter. If you've had the pleasure of operating a recent desktop transceiver with digital signal processing (DSP) features or a software-defined radio (SDR) transceiver, you know their signal-filtering abilities are excellent.

But there are still a lot of older analog transceivers in use, not to mention all those low-power (QRP) kit transceivers. Of course, for older transceivers that will accommodate them, there are crystal and mechanical intermediate-frequency (IF) filters you can install. Good IF filters can provide a major performance boost, but they often come with significant price tags.

An alternative is to perform filtering at the audio stage.

SOTABEAMS External DSP Audio Filter

Based in the United Kingdom, SOTABEAMS is known for offering useful products for amateurs who enjoy portable operating (as in *SOTA* — Summits on the Air) where size, weight, and power consumption are critical factors. Many portable operators use low-power transceivers, and the majority of these are analog radios.

With this group in mind, SOTABEAMS has developed a series of DSP audio filter modules that can be installed within many transceivers. For those who would rather not take that approach, they also offer an external audio filter that incorporates one of their DSP modules and adds a few controls. That's what I'll be evaluating in this review.

The SOTABEAMS external DSP filter is tiny — just 3⅓ × 2½ × 1 inches. At the front of the enclosure, there is a volume control on the left side (labeled **VOL**), a red **LVL** LED that warns when you are feeding too much audio to the filter, and a green **SIG** LED that lights when you've properly tuned the target signal. More about that in a moment. There is also a small toggle switch (**W/N**) to select wide or narrow filter bandwidths.

At the rear of the filter, shown in Figure 3, you find two 3.5-millimeter jacks for the audio inputs and outputs, as well as a coaxial dc power socket. You can power the filter from any dc source that can supply 5 to 15 V at about 70 mA.

SOTABEAMS
DSP Filter
Lvl
W/N
Sig

When ordering, you must specify the desired filters:

SSB + CW (Wide: 2,700 Hz and Narrow: 300 Hz)

CW wide + CW narrow (Wide: 1,000 Hz and Narrow: 300 Hz)

SSB wide + SSB narrow (Wide: 2,700 Hz and Narrow: 2,400 Hz)

For this review, I chose the SSB + CW configuration. Note that filter bandwidths are fixed at the values shown above, and they are not adjustable. Measurements in the ARRL Lab confirmed that both filters are very close to their specified bandwidths. Swept frequency response plots are available from **www.arrl.org/qst-in-depth**.

Putting the Filter to the Test

Using an analog HF transceiver, I attached a cable between the radio's headphone jack and the input of the SOTABEAMS filter. At the filter output, I plugged in a set of headphones. (Later I also tried a small speaker and was surprised at how loud the filter output could get.)

Bottom Line

The SOTABEAMS external DSP audio filter can improve selectivity to help separate signals on crowded bands. It's especially useful with simple QRP transceivers and older analog transceivers without DSP features or narrow IF filters.

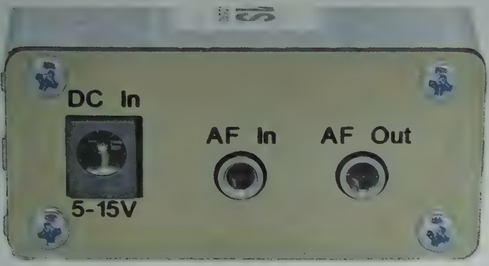


Figure 3 — The SOTABEAMS DSP filter rear panel has jacks for dc power, audio in, and audio out.

I turned up the transceiver volume until I achieved a comfortable listening range with the filter's **VOL** control while not causing its red **LVL** LED to flash. With the 2,700 Hz filter mode selected, I browsed a few SSB signals and was impressed with how well the SOTABEAMS filter enhanced the overall audio quality. I really didn't expect to hear a significant effect, but the SOTABEAMS filter made an obvious improvement.

The best was to come when I switched to CW. A CW contest taking place during the weekend after I received the filter provided an ideal environment for testing. Tuning into the CW portion of 20 meters, several signals popped through the 2,700 Hz filter simultaneously. When I switched the SOTABEAMS filter to narrow, however, the effect was pronounced. What was previously a chaotic mess became far easier to navigate.

Keep in mind that the filter is working at audio frequencies rather than RF, so its performance can be affected by such things as AGC pumping from strong nearby signals (where the desired signal level rises and falls as the receiver reacts to those nearby signals). Even so, the ability of the SOTABEAMS filter to impose a significant degree of order on the cacophony was remarkable. You can download an MP3 audio file and listen to the SOTABEAMS filter in action at **www.arrl.org/qst-in-depth**.

Switching back to the wide filter, I tuned again while watching the signal-tuning LED. This LED is driven by an independent DSP filter centered in the CW passband at 750 Hz. So, whenever I saw the green **SIG** LED pulsing to the beat of a CW signal, I knew I could immediately switch to the narrow filter and find that it was perfectly tuned. This became one of my favorite features.

A Worthwhile Addition

An external audio filter — even a DSP model such as this one — can't work miracles. It won't match the performance of a quality IF filter, and it will fall far short of what can be achieved in a software-defined radio. Still, the SOTABEAMS DSP filter made a vast improvement to my analog QRP radio, especially for CW operating, and it did so at an attractive cost.

Manufacturer: SOTABEAMS, Macclesfield, United Kingdom; **www.sotabeams.co.uk**. Price: $73.44.

RigExpert Stick Pro 0.1 – 600 MHz Antenna and Cable Analyzer

Reviewed by Phil Salas, AD5X
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I reviewed the RigExpert Stick 230 antenna and cable analyzer in the June 2020 issue of *QST*, so I was interested in taking a look at the new Stick Pro. Like the Stick 230, the Stick Pro is quite compact, making it convenient for field measurements. It can be carried around your neck with the included lanyard, or it easily fits in a pocket or go bag. The Stick Pro adds some nice features compared to the Stick 230, such as a TFT color display, extended frequency range, and both audible and tactile feedback whenever you press a key. However, the operation and features of both analyzers are quite similar. More information is available in the manual available on the RigExpert website.

Stick Pro Overview

The Stick Pro is a single-port vector network analyzer (VNA) that provides signed, complex impedance measurements of RF loads from 100 kHz to 600 MHz, with a frequency resolution of 1 kHz. While the measurement port is a type N female, a UHF-to-N adapter is included. A USB A/C cable is provided for computer interfacing and charging of the internal lithium-ion battery. A battery indicator on each of the three main menus shows the battery status. A two-page *Cheat Sheet* is included with the Stick Pro, and a full user manual is available from **rigexpert.com**. There is also a Bluetooth LE interface to permit display and control from an iOS or Android device.

All information is displayed on a 1 × 1 inch TFT color screen, which I found easy to see even in strong sunlight. You can select single-frequency or swept-frequency displays of many of the measured parameters. Table 2 summarizes key specifications.

Using the Stick Pro

Prior to using the Stick Pro for the first time, go to the RigExpert website and download *AntScope2* software (Windows, macOS, and Linux versions are available), along with the *Flash Tool* for Windows or macOS. Install *AntScope2*, and then connect your Stick Pro USB cable to your computer, which automatically powers on the Stick Pro. Now open the downloaded *Flash Tool* file and the *Flash Tool* will automatically determine if there is a newer version of firmware available. If so, it will automatically update your firmware. It's all very easy to do. While you're in the downloading mode, grab your smartphone or tablet and download *AntScope* for iOS or Android.

The Stick Pro operation takes a little getting used to because there are only six keys on the unit, but it is not difficult to learn. If you use the Stick Pro infrequently, keep the manual or *Cheat Sheet* on hand for quick reference.

A quick press of the □ key at the lower right, or a long press of any of the top four keys, will power on the unit. At turn-on, the display will momentarily show Antenna Analyzer 600 MHz, the serial number, and the firmware version. Then the Stick Pro will display the first of three main menus (see Figure 4), which is for antenna measurements. (The label **SHEET** with the top two measurement modes refers to display of the measurement results as numbers, while **CHART** at the bottom refers to display of results as charts as well as numbers.) A second tap of the □ key brings up the **TOOLS** menu, and another tap of the □ key will bring up the **CABLE** menu. Press and hold the □ key to turn off the unit.

In the first menu, a tap of the > key at the lower left provides screens with descriptions of the measurement options, and it also provides access to user-adjustable settings. This includes open/short/load (OSL) calibration if desired. While the Stick Pro is shipped fully calibrated, you may wish to do an OSL calibration at the end of a coax feed line, so you can take remote measurements. OSL calibration only takes about 2 minutes. For more information, see the sidebar, "Open/Short/Load Calibration Loads."

Open/Short/Load Calibration Loads

Sometimes it is convenient to calibrate out the interconnecting coax cable to be able to make a remote antenna measurement. To do this, you need to run through the open/short/load (OSL) calibration routine, where the open, short, and load are placed at the end of the cable. Of course, if you calibrate with the cable, you'll need to calibrate again right at the Stick Pro output to return everything to normal, as the Stick Pro only saves the last calibration file. The procedure takes about 2 minutes. See **www.arrl.org/qst-in-depth** for details of the components and procedure used.

Table 2
Stick Pro Manufacturer's Specifications

Frequency range: 0.1 to 600 MHz with 1 kHz resolution for 25, 50, 75, 100, 150, 200, 300, 450, and 600 Ω systems.
SWR measurement range: 1 to 100 in numerical modes, 1 to 10 in chart modes.
Impedance ranges: R = 0 to 2,000 Ω, X = –2,000 to 2,000
SWR chart: 100 points.
SWR chart at fixed ham bands by IARU regions: 100 points.
RF output: Square wave, 0.1 to 600 MHz, at –10 dBm into 50 Ω.
Operating temperature: 32 – 104 °F.
Dimensions: 7.3 × 1.6 × 1.3 inches. Weight: 6.5 ounces with battery.

Bottom Line

The Stick Pro antenna and cable analyzer is accurate, lightweight, and rugged. It will provide all the antenna, transmission line, and component evaluation needs of hams and professionals alike.

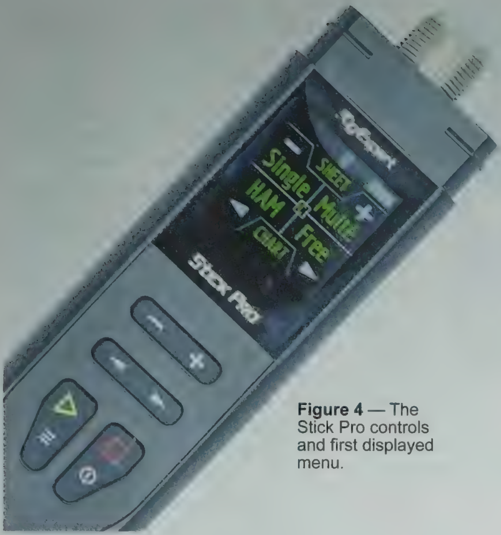


Figure 4 — The Stick Pro controls and first displayed menu.

Antenna Measurements

The first menu offers several measurement options. In the **SINGLE** mode, you can sequentially display fixed frequency values of SWR and return loss (screen 1), *Z*, *R* and *X* (screen 2), *L*s and *C*s (screen 3), *R*p and *X*p (screen 4), and *L*p and *C*p (screen 5). I used the **SINGLE** mode to take the data shown in the measurement tables presented in this review.

The **MULTE** mode scans the entire 100 kHz to 600 MHz frequency range and displays all frequencies where the SWR is less than 3:1. You step through the found frequencies with the left and right arrow keys in the center row of buttons.

The **HAM** mode displays SWR graphically on each of the ham bands (plus 11 meters). You step through the bands with the left and right arrow keys. Once a band is selected, you can adjust the swept bandwidth with the – and + keys on the top row of buttons. You can change the center frequency with the left and right arrow keys. Figure 5 is an SWR scan of a 15-meter antenna using the **HAM** mode.

The **FREE** mode lets you set up a user-defined swept-frequency range. This is useful for sweeping a non-ham frequency range or looking at multiple resonances that you might find in a multiband antenna.

Table 3
Stick Pro Measured Open Circuit Impedance
Stick Pro serial number 00178, Firmware v. 1.3

Frequency (MHz)	Output (*Z*) (Ω)	Frequency (MHz)	Output (*Z*) (Ω)
1.8	>5,400	50	>1,500
3.5	>5,300	146	>500
7	>5,000	222	>370
14	>4,000	440	>180
28	>2,600		

In all cases, you can change frequency in two ways. First, tapping the left or right arrow key will decrement or increment the frequency in small steps. Pressing and holding one of these keys will change frequency in an accelerating manner. The second way to change frequency is to press the > key for 2 seconds. This brings up a screen that permits changing the individual frequency digits using the left and right arrows and the – and + keys. After you've changed the digits, tap the > key to set the frequency.

Other Measurements

The **TOOLS** menu displays the Bound, TDR, *R* and *X*, and Rloss tools. The Bound mode permits looking at a single-frequency SWR or return loss. The TDR (time-domain reflectometer) tool is a great way to find any problem areas in your transmission line. It shows blips on the plot where discontinuities or impedance bumps occur, as well as permitting a readout of the physical distance to these anomalies. You can also determine the physical length of your transmission line by disconnecting the far end, as this will show a major discontinuity at that point. The *R* and *X* (resistance and impedance) mode permits measuring the complex input impedance of an antenna system or filter, and the plot output makes it easy to find the resonant frequency of your antenna system even if the SWR is

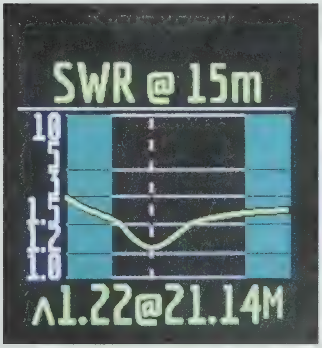


Figure 5 — An SWR plot of a 15-meter antenna viewed on the Stick Pro in the **HAM** mode.

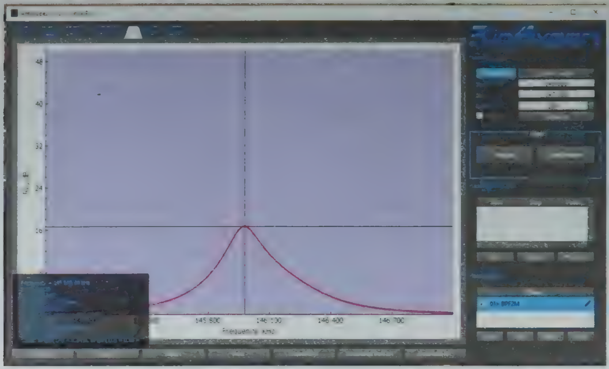


Figure 6 — The *AntScope2* return loss sweep of a 2-meter bandpass filter.

Table 4
SWR Load Measurements
Measurements with the Stick Pro compared to Array Solutions VNAuhf

Freq. (MHz)	1.0:1 SWR Pro/VNA	1.9:1 SWR Pro/VNA	3:1 SWR Pro/VNA	4.4:1 SWR Pro/VNA	8.7 SWR Pro/VNA
1.8	1.0/1.0	2.00/2.02	3.2/3.2	4.7/4.6	11/11
3.5	1.0/1.0	2.00/2.01	3.2/3.2	4.7/4.6	11/11
7	1.0/1.0	2.00/2.01	3.2/3.2	4.7/4.6	11/11
14	1.0/1.0	2.00/2.01	3.2/3.2	4.7/4.6	11/11
28	1.0/1.0	2.00/2.00	3.2/3.2	4.7/4.6	11/11
50	1.0/1.0	2.00/2.00	3.2/3.2	4.7/4.6	11/11
146	1.0/1.0	1.99/1.98	3.2/3.2	4.8/4.8	10/10
222	1.0/1.0	1.98/1.95	3.3/3.2	5.1/4.9	11/10
450	1.0/1.0	1.97/1.98	3.7/3.2	5.6/5.3	13/9

Table 5
Stick Pro Complex Load Measurements
Stick Pro compared to Array Solutions VNAuhf measurements of SWR and series resistance/capacitance

Frequency (MHz)	------ Stick Pro ------ SWR	Rs + Cs	------ VNAuhf ------ SWR	Rs + Cs
50	1.98	48 Ω + 94 pF	1.97	48 Ω + 95 pF
146	1.83	45 Ω + 38 pF	1.83	46 Ω + 37 pF
222	1.78	42 Ω + 28 pF	1.77	43 Ω + 28 pF

high. This is good for adjusting the tap on a matching network to improve the SWR at a given resonant frequency. Finally, the RLoss (return loss) mode is a more sensitive means of measuring an antenna system or filter match as compared to SWR. It plots the results as well as displays the result numerically.

From the **TOOLS** menu, another short tap of the ◘ key brings up the **CABLE** menu. From this menu, you can determine ¼- and ½-wavelength stub lengths (StubT), the length and velocity factor of a connected cable (cLen), the characteristic impedance of a connected cable versus frequency (cImp), and the loss of a connected cable versus frequency (cLoss).

Stick Pro Testing

I began my tests by checking the Stick Pro output against WWV at 10 MHz. I could not discern any difference in frequency between the two tones. Next, I found the signal frequency output level to be –8.6 dBm over the full frequency range. Of course, the Stick Pro outputs more of a square wave, so there is high harmonic content in this measurement. As I only have a broadband power meter that responds to the power in the harmonics as well as the fundamental, I'd estimate that the fundamental frequency level is close to the –10 dBm specification.

Next, I recorded the Stick Pro's open-circuit impedance measuring capability. This gives an indication of the impedance magnitude that can be accurately measured as a function of frequency. The results are tabulated in Table 3.

To test SWR accuracy, I checked the Stick Pro against a precision 50 Ω load, and then shorted microwave attenuators of 5 dB (1.92:1 SWR), 3 dB (3.01:1 SWR), 2 dB (4.42:1 SWR) and 1 dB (8.7:1 SWR). Because the attenuators are not perfect, I also measured them on my Array Solutions VNAuhf for comparison, as shown in Table 4. Both devices were calibrated with the same OSL components. The Stick Pro SWR readings compare quite favorably to the VNAuhf readings.

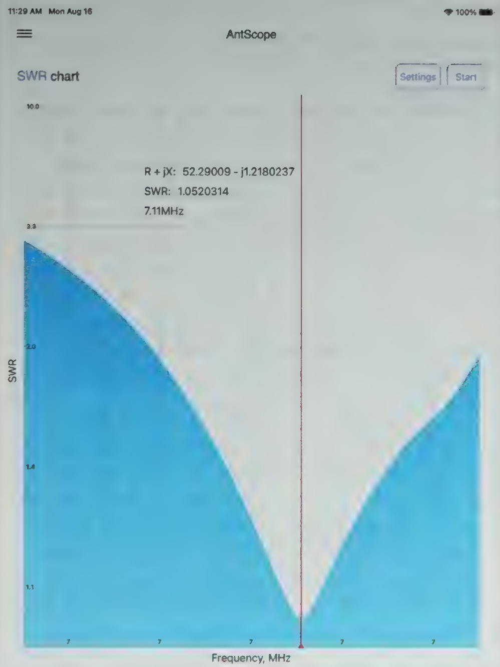
For my final tests, I used series resistive/capacitive (RC) complex loads with an SWR of approximately 2:1 at 50 MHz, 146 MHz, and 222 MHz. Table 5 displays the Stick Pro measurements compared to the VNAuhf. As you can see, the Stick Pro provides measurements almost identical to those seen on the VNAuhf.

AntScope for iOS and Android

An *AntScope* app provides the capability to control the Stick Pro and display measured data on iOS or Android devices via a Bluetooth LE (BLE) connection. I loaded *AntScope* for Android on my older smartphone (Android 6, which is the earliest supported version) and *AntScope* for iOS on my iPad (iOS 14.7.1).

In the iOS app, available menu choices are SWR Chart, Smith Chart, All Parameters, and TDR Chart. The **SETTINGS** screen is for specifying the measurement frequency range in kHz (either start/end frequencies or center frequency/span) and the number of measurement points. Although the latest version of *AntScope* for iOS in the App Store (v 1.4.5) recognized the device as a Stick Pro, the highest available End Frequency in **SETTINGS** was 230000 kHz (230 MHz, the top end of the Stick 230). It appears that the app is yet to be fully updated for the new model. Also, I was unable to find a way to save or export measurements made while the Stick Pro was controlled from the app. Figure 7 shows an SWR chart viewed in the iPad.

The latest version of *AntScope* for Android on Google Play was version 2.28. Unlike the iOS version, this allowed a Stop frequency up to 600 MHz with the Stick Pro connected. Measurement choices across the top of the screen are SWR, Phase, impedance ($Z = R + jX$ or $Z = R|+|jX$) and return loss (RL), and the measurements are displayed as plots. In the One FQ mode, you can display multiple measured parameters at a single frequency. Measurements and plots can be saved, recalled, and exported. At times, I found it difficult to establish and maintain the BLE connection between the Stick Pro and my Android phone. Some reviews on Google Play reported similar connectivity problems. I didn't experience that with the iPad. — *Mark Wilson, K1RO*



R + jX: 52.29009 - j1.2180237
SWR: 1.0520314
7.11MHz

Figure 7 — SWR chart for a 40-meter dipole measured with the Stick Pro and the *AntScope* iOS app. The app automatically indicates the low SWR point (red line) and displays the frequency, SWR, and impedance measurements.

Computer Interface

As discussed earlier, the supplied USB cable provides for charging the internal battery and firmware updates when plugged into your computer, as well as interfacing with the *AntScope2* software program. *AntScope2* permits display of SWR, phase, impedance, return loss, Smith Chart, and TDR plots. *AntScope2* also permits importing and saving data from the Stick Pro memory, as well as providing real-time control of the Stick Pro.

Figure 6 shows the *Antscope2* return loss display of a 2-meter band-pass filter. Note that the return loss is displayed inverted from what is normally seen in other VNA software. I was unable to run the OSL calibration from *AntScope2*, as it would lock up on me part way through. This was unfortunate, as it appears that you can save multiple sets of calibration data when using *AntScope2*. This would be convenient for storing calibration for different cable lengths and quickly being able to reload the normal calibration file. (For more on using the Stick Pro with mobile devices, see the sidebar, "*AntScope* for iOS and Android").

Conclusion

The standalone Stick Pro works quite well. It is very accurate and is more compact and less expensive than the RigExpert AA-600 analyzer that covers a similar frequency range. Although it's not perfect, the companion *AntScope* software for PC and mobile devices is useful for viewing and manipulating measured data on a larger screen. See **www.arrl.org/qst-in-depth** for additional illustrations and information about the Stick Pro.

Manufacturer: Rig Expert Ukraine Ltd., Kyiv, Ukraine; **www.rigexpert.com**. Available from several US dealers. Price: $390.

Digirig Mobile Digital Mode Interface

Reviewed by Steve Ford, WB8IMY
wb8imy@arrl.net

Don't let the name of this product mislead you. Digirig Mobile is a digital transceiver interface for any application, mobile, or otherwise. This tiny device will allow almost any transceiver to interface with any computer that sports a USB port. With Digirig Mobile, your digital-mode software can switch the radio between transmit and receive. If your transceiver offers computer-aided transceiver (CAT) functionality, Digirig Mobile provides a serial data interface to allow your software to control various transceiver functions. Digirig Mobile also contains its own audio codec to process audio to and from the radio.

The Digirig Mobile has a black aluminum enclosure that measures 1.5 × 1 × 1 inches, or about the size of a 9 V battery, and it weighs just 1 ounce. At one end of the case is a USB-C port for the cable to your computer. At the opposite end are two 3.5-millimeter jacks — one for serial data and the other for transmit and receive audio. There are no switches or indicators. The computer supplies dc power via the USB cable.

Setting Up Digirig Mobile

Digirig Mobile uses the common CP2102 serial interface, so chances are good that your computer already has the CP210x driver. This was the case for my Windows 10 laptop. When I plugged in the USB cable, the laptop quickly located and installed the driver, creating a virtual COM port. Bringing up the Windows Device Manager, I saw the new port and made a note of its number. At the same time, Windows recognized the Digirig Mobile audio codec as an "audio device" and added it to the list of audio inputs and outputs.

For this review, I used Digirig Mobile with a Yaesu FT-818 transceiver. High-quality cables specifically wired for your radio are options available at an additional cost, so I purchased the coiled cable set for the '818. Digirig Mobile offers cables for the Yaesu FT-100, FT-817/FT-818, FT-857, FT-857D, FT-891, FT-897, and FT-897D transceivers, as well as the Xiegu G90 and X5105 transceivers. Of course, you can make up your own cables and the Digirig website (**www.digirig.net**) offers detailed wiring diagrams.

Digirig Mobile does not come with a USB-C to USB-A cable, but these are inexpensive and commonly available. The Digirig website sells a well-made, coiled USB cable for $8.97.

digirig
mobile

It is important to point out that Digirig Mobile can be used with transceivers that don't support CAT functionality, including handheld radios. There is a set of pads on the interface circuit board that can be easily bridged with bits of solder. By doing so, the TxD and RxD serial lines become non-inverting open-collector drivers controlled by the RTS and DTR lines of the virtual COM port. These drivers can be used to control the transceiver's PTT and CW key lines. Instructions on the website explain this.

Digirig Mobile developer Denis Grisak, K0TX, is also exploring the possibility of a simple modification that would add CI-V compatibility for Icom radios.

Digirig Mobile on the Road

As simple as Digirig Mobile is to set up and use, I thought a good test would be to take it on an impromptu Parks on the Air (POTA) expedition to a nearby park. I packed up the laptop computer, my FT-818, the Digirig Mobile interface, a sealed lead-acid battery, a portable HF vertical antenna, and headed out. Within minutes, I had my station up and running with *WSJT-X* software and making contacts using FT8 (see Figure 8). *WSJT-X's* CAT function had no difficulty "talking" to the FT-818 transceiver through the Digirig Mobile interface once I selected the proper COM port. *WSJT-X* also recognized the audio codec inputs and

Bottom Line

The Digirig Mobile offers a seamless way to add a digital mode interface to transceivers without that capability built in. For plug-and-play setup, check out the optional cables if you have a compatible radio.

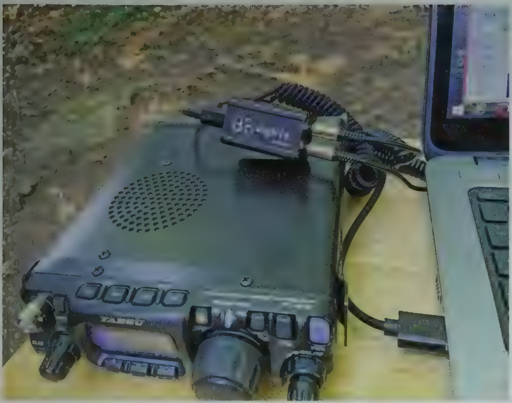


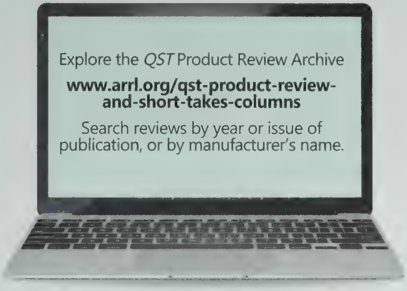
Figure 8 — The Digirig Mobile interface resting atop my Yaesu FT-818 transceiver. During this Parks on the Air activation, it worked perfectly for FT8 and PSK31 operating.

outputs. The receive level was somewhat high, so I accessed the audio codec device properties in the Windows Control Panel and adjusted it accordingly.

Switching to *fldigi* software, I chased down a few PSK31 contacts. I had to reconfigure *fldigi* to use the Digirig Mobile COM port and the audio inputs and outputs, but once communication with the interface was established, everything went smoothly.

Digirig Mobile is about as close to a plug-and-play digital-mode interface as you're likely to find. The interface does not come with a user manual; it is a matter of simply plugging in the cables, and you're on your way.

Manufacturer: Digirig, P.O. Box 2451, Grand Junction, CO 81502; **www.digirig.net**. Digirig Mobile interface, $39.97; pre-wired cables for Yaesu FT-8xx series transceivers, $29.97; pre-wired cables for Xiegu G90 and X5105 transceivers, $19.97.



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August 2021
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Hiroki Kato
AH6CY

In his article, "The Tin-Can Tower Vertical," Hiroki shows what can be done with scrap parts that might normally wind up in a landfill.

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The Tin-Can Tower Vertical

An effective 15-meter portable antenna made from coffee cans.

Hiroki Kato, AH6CY

I drink a lot of Italian Illy coffee, and wanted to use the abundant amount of coffee cans on a radio-connected project. Remembering an old article about a vertical antenna made from beer cans soldered together, I wanted to reproduce that with the coffee cans, which are 3.5-inch-diameter steel cans and could be easily soldered together with a 100 W soldering iron. Further, the larger the diameter of an antenna, the broader the frequency coverage, and the more efficient it is due to the increased radiating surface.

Dave Casler, KE0OG, askdave@arrl.org

Ask Dave

Get more information from the "*QST*: Ask Dave" YouTube playlist at **https://bit.ly/3z2MBMI.**

Poor Transmit Audio Setup Leads to Splatter

Antenna Tuners Shouldn't be in Series

Q Frederick Baumgartner, K0FMB, of Colorado, asks: I've seen linear amplifiers with autotuners that include a warning to bypass the internal tuner if an external antenna tuner is in use. I can understand the folly of two automatic tuners in line chasing each other into the depths of destruction. However, I use a double-balanced tuner with wire antennas that often doesn't quite get to a 1:1 match. What would be wrong with having the amplifier's (or radio's) internal autotuner correct for the last little mismatch to a manual tuner?

A You're right that the general guidance is not to string multiple antenna tuners in series. Although tuners are conceptually simple devices, usually consisting of a couple variable (or switchable) capacitors and a variable (or switchable) inductor. When two are strung together, the underlying reactive circuit becomes far more complex, and the two tuners can react with each other in unpredictable ways. Voltages can become very high and tuner elements can be damaged.

An SWR that is not quite 1:1 may be perfectly acceptable. Some instruction books say the antenna system should have an SWR of 1.6:1 or less; others say 2:1. I do not use an external tuner at all. I have a 500 W amplifier, and do not have a tuner big enough to handle that. So, I try to prune my antennas so they all present a reasonable SWR — less than 1.6:1 — to the radio or amp. When I'm just using the radio, I will let the internal tuner touch things up. Rather than giving all your attention to the SWR, look at other factors, such as how high you can get the antenna, nearby large metal objects that might obstruct propagation, the strength of the guys, how well it will stay up in the event of a windstorm or ice storm, and signal strength of received signals. Use your *WSJT-X* setup on WSPR, so you can see where your antenna is being heard.

I recommend using your favorite tuner that gets the SWR down to about 1.6:1 and just going with it. You'll hear and be heard across your favorite bands.

Pennant Antennas

Q Rob Steenweg, VE1CHW, of Nova Scotia, Canada, asks: Why can't I find a pennant antenna design optimized for 40 meters? I have found designs for 160 and 80 meters, but not for 40 meters.

A The pennant antenna belongs to a group of non-resonant antennas, like the Beverage and flag antennas, and as such, they have high directivity, low gain, and very low noise. In form, they're part of the set of wave antennas, such as the open V and the rhombic. They were developed back when 1 MHz was considered a high frequency. With a preamplifier, they are great as receiving antennas. They work because the noise picked up is so much less than the signal. They are not transmitting antennas. Will they transmit? Yes, but much less than a dipole or properly loaded vertical.

You must consider the wavelength involved. These antennas work at low frequencies. For ham radio, that would mean 160 meters and 80 meters. You might get some good results on 60 meters. However, 40 meters is getting well out of the range where the signal travels close enough to the ground that it can be picked up without picking up noise. Note that because these antennas are non-resonant, one built for 160 meters may work well on higher frequencies, but by the time you get to 40 meters, you're probably getting very little useful work from them.

In an odd way, this is an exception to the rule that you can scale antennas for a higher or lower frequency. These specialized antennas don't scale much, having an upper frequency limit.

Using 40-Meter Antennas for 15 Meters

Q James Burrough, N5DTT, of Texas, asks: Some hams commonly use their 40-meter dipoles as 15-meter antennas. Is there any advantage on 15 meters as to gain or radiation pattern, or is this just a convenient way to be on both bands?

A I've done this many times. A 40-meter half-wave antenna is a three-half-wave antenna on 15. There are sticky things in the details, though.

I used *EZNEC 6+* to model a simple 40-meter dipole at 35 feet, which would be a common height for many amateurs. An optimum height would be 66 feet, but most hams (me included) can't get an antenna that high. Figure 1A shows the very common elevation pattern for the 40-meter dipole at this height. Unsurprisingly, most of the radiation goes up. Figure 1B shows the azimuth pattern, which, for an antenna over ordinary ground, is pretty omnidirectional. Now watch what happens to the elevation pattern in Figure 1C when a 40-meter dipole is used on 15 meters. About half the radiation goes up, and the other half to the horizon. It becomes very clear when you look at the azimuth pattern in Figure 1D. There are six lobes and some deep nulls too. So, whether you can work someone on 15 meters depends very much on how your antenna happens to be oriented with respect to the other ham.

There is one other problem pointed out by the modeling. If your antenna is cut for 7.15 MHz (the midpoint of the 40-meter band), the SWR on 15 meters can be quite high, varying from about 3:1 at the top of the band up to about 8:1 at the bottom of the band. Whether your rig's built-in antenna tuner can handle this depends on many variables. If it can't, you can try an external wide-range tuner.

Or, just put up a dipole cut for 15 meters. The pattern will be much more omnidirectional. Furthermore, the half-wave height for this antenna is just 22 feet (6.7 meters).

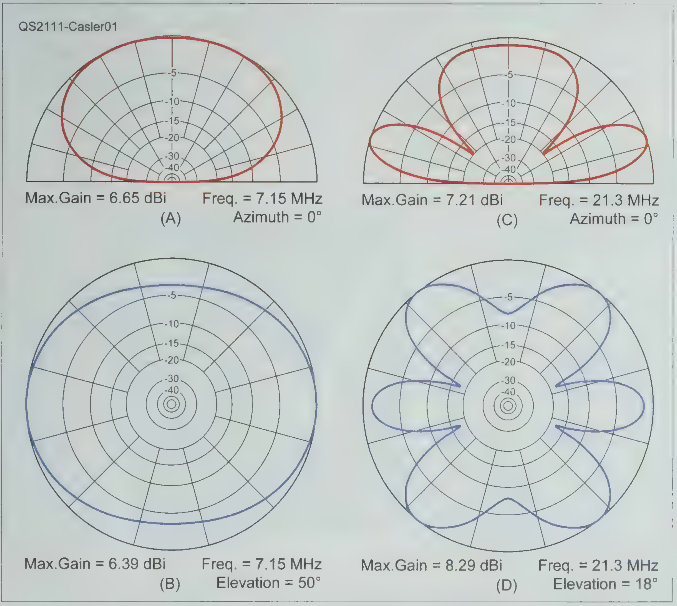


Figure 1 — *EZNEC* modeling showing results of using a 40-meter dipole at 35 feet above ground. (A) shows the elevation pattern of the dipole used on 40 meters. (B) shows the azimuth pattern, which is not quite omnidirectional, but it is close. (C) shows the elevation pattern when the 40-meter dipole is used on 15 meters. (D) shows the azimuth pattern with its six beam patterns and some deep nulls.

Splatter

Q Eric Johnson, KD9RNA, of Wisconsin, asks: During the Great American QSO Party, I noticed there were many calls that showed up at several points on the band — I believe this is called *splatter.* Can you explain what is going on, and what I should do to make sure I'm not guilty of the same thing?

A The sounds you are hearing are indeed called *splatter* — RF energy emitted by a transmitter outside the intended transmit bandwidth. It's caused because something in the audio or RF chain is being over-driven (microphone gain set too high) to the point that the circuit in question becomes nonlinear. This nonlinearity causes internal mixing and can create RF energy outside the normal RF bandwidth. This can occur if there's too much signal compression, which distorts audio so it can't be understood, and can create audio components that are out of band. It can also occur if the transceiver's final RF amplifier is overdriven (which is hard to do with modern transmitters), or the station's high-power amplifier is being overdriven.

Splatter is frowned upon because the out-of-band signals cause interference. Furthermore, it's pointless because the energy sent where it shouldn't go means that the actual signal has less power, and it's usually badly distorted and hard to understand. This is the great paradox of splatter: the operator tries so hard to be heard that the audio is hard to understand.

It's harder to create splatter with modern radios, because they have internal feedback circuits, but it is still possible. To avoid creating splatter, get out your rig's manual. Follow the instructions exactly for setting your microphone gain and again for setting your audio compression. If someone else listens for you as you do this, they'll tell you that your signal is clear and understandable. Adding compression beyond this level becomes counterproductive, because while it may sound louder, it starts to get distorted. Stick with the instructions in the manual.

Check out the "*QST:* Ask Dave" YouTube playlist at **https://bit.ly/3z2MBMI** for the video answer to this question.

Send your questions to **askdave@arrl.org**, or fill out the form at **www.ke0og.net/ask-dave**. I answer some questions here, and some via videos on my YouTube channel (**www.youtube.com/davecasler**), or during my weekly livestream on Thursdays at 6:45 to 8:15 PM Mountain Time on my channel.

Hints & Hacks

A Customized Station Clock

I've designed a unique station clock that simultaneously reads in both UTC and local time. The magic of this clock lies in its uncommon arrangement of numerals.

In Figure 1, you can see that there is an 8 where a 12 would normally be. This is because the "out-of-phase" numerals are UTC, not local time; you don't need numerals to determine local time. Therefore, the numbers on this clock display UTC only.

Try reading the clock yourself. Are you able to read the local time in Figure 1? Clearly, it is 8 minutes after 9. How about UTC? Again, it is easy to see that it is 8 minutes after 5.

Of course, the UTC numbers must be different for each local time zone. For my home in California, the UTC offset is local time plus 8 hours. That's why there's an 8 where a 12 would normally be. You will find number templates to download for the six main US time zones on the *QST* in Depth page at **www.arrl.org/qst-in-depth**.

The little numbers on the outer rim are also UTC, but only for when your time zone is observing Daylight Saving Time.

More Personalization

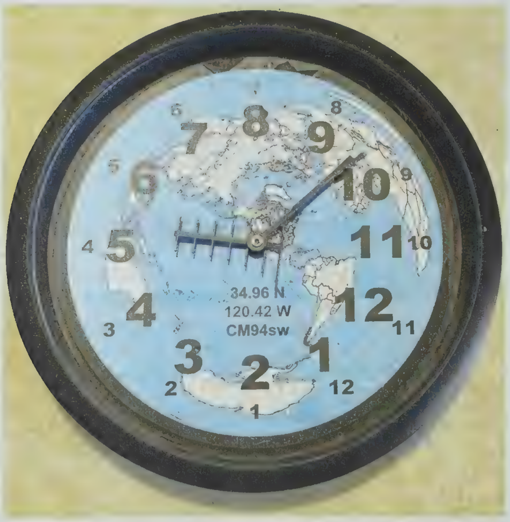
I like the idea of custom hands with a bit of ham radio flair. I own a 3D printer, so it was easy for me to make hands with a theme. (If you don't own a 3D printer, there may be a ham in your area who does.) I chose a multi-element Yagi antenna for the hour hand and a length of coax with a PL-239 connector for the minute hand. You may, if you wish, use stock hands. The 3D printer STL files for my custom hands are available at **www.arrl.org/qst-in-depth**.

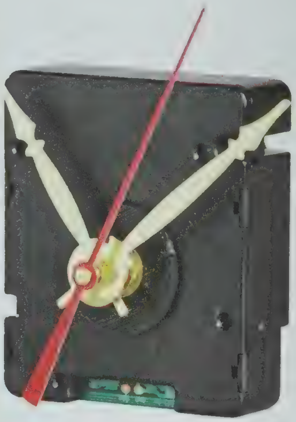
As a final touch, and one which is very handy for operating, I added my Maidenhead grid square number and my latitude and longitude to the clock face.

This project uses an inexpensive clock you can find on Amazon for about $11. Just go to **www.amazon.com** and search for "Bernhard Products Black Wall Clock." Look for the 10-inch model.

However, this project does not use the quartz movement that comes with the clock. I wanted the additional accuracy of a WWV-synchronized clock for my station. An inexpensive 60 kHz WWV synchronized "atomic" replacement movement is available from **www.klockit.com**. It is a 1:1 snap-in fit for most quartz clocks (see Figure 2).

The atomic movement is also better than the stock unit in that it accepts much thicker modified or 3D-printed plastic hands. I used glue-on card stock cutouts to customize the hands





◀**Figure 1** — A customized station clock. It is based on an inexpensive Bernhard Products clock that has been fitted with a few personalized features.

▲**Figure 2** — The WWV-synchronized 60 kHz "atomic" replacement movement from Klockit.

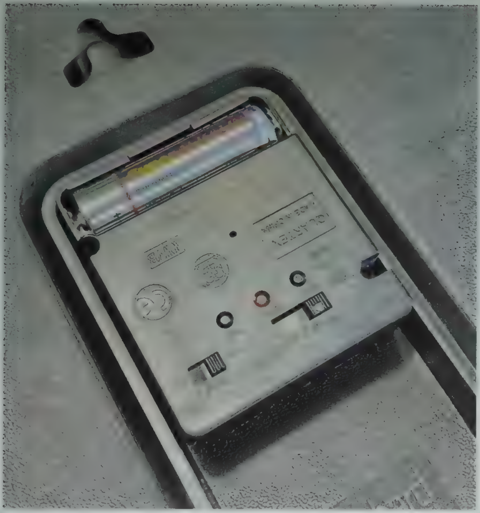


Figure 3 — The Klockit movement mounted in its inverted position in the support fixture.

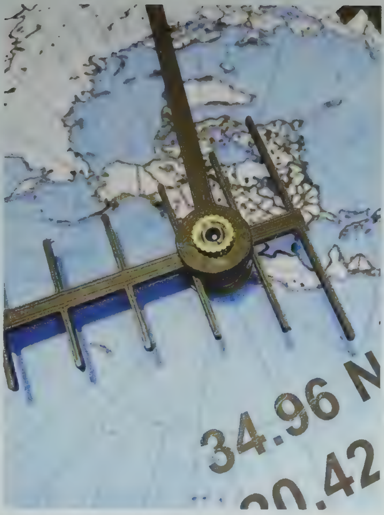


Figure 4 — Custom 3D-printed hands secured on the motor shaft.

on my initial prototype. You may do the same with this movement using any of the stock hands.

If you have experience with *Photoshop* or similar graphics software, you may wish to add a background image. I used an azimuthal map of the world, centered on my location. Tom Epperly, NS6T, provides maps at his website at **ns6t.net/azimuth/azimuth.html**. On that site, you can customize and download an azimuthal map centered on your location, at a radius of your choice.

Align the numerals template for your time zone, the background image, and the text of your Maidenhead grid square and latitude and longitude. This can easily be done using the "Layers" functions of your graphics program. Print the result as the new face on heavy-weight card stock. If your 8½ × 11 inch printer cuts off the image at the edge, resize the face to compensate, or join together two sheets of card stock for a face that is wider than your printer allows.

Construction

Disassemble the case. Pull off the hands and remove the existing face. Unscrew the motor nut and remove the movement from the mounting fixture on the back.

Glue the new face in place and cut out the center hole with a hobby knife. Push the new atomic movement into the fixture from the back and secure it in the case with the nut and washer supplied (see Figure 3). It is larger than the stock movement and must be mounted upside down. During initial setting of the atomic movement, as detailed in the supplied instructions, you will need to pull off and then reattach the hands in inverted positions because of the upside-down movement.

Using my 3D-printed hands, the Yagi-beam hour hand slides onto the largest shaft diameter of the Klockit motor using light pressure (see Figure 4). I recommend first manually running a 15⁄64-inch drill bit carefully through the mounting hole in the hand. Go easy; the hand is strong but breakable. Do not use a drill motor or drill press. The minute hand also pushes on and is secured with the small, knurled nut supplied with the motor. Pay attention to the alignment flats in the mounting hole in the hand. Synchronizing instructions for the atomic movement come with the motor. — *73, John Portune, W6NBC,* **jportune@aol.com**

All photos by the author.

"Hints and Hacks" items have not been tested by *QST* or ARRL unless otherwise stated. Although we can't guarantee that a given hint will work for your situation, we make every effort to screen out harmful information. Send technical questions directly to the hint's author.

QST invites you to share your hints with fellow hams. Send them to "Attn: Hints and Hacks" at ARRL Headquarters, 225 Main St., Newington, CT 06111, or via email to **hh@arrl.org**. Please include your name, call sign, complete mailing address, daytime telephone number, and email address on all correspondence. Whether you are praising or criticizing an item, please send the author(s) a copy of your comments.

Steve Ford, WB8IMY, wb8imy@arrl.net

Eclectic Technology

Notes from the CW Software Front

For many years, I've had a certain fascination with CW decoding software. You'd think that a relatively straightforward coding scheme — International Morse — applied to simple on/off transmitter keying would lend itself well to decoding with software. While progress has been made in this area, after more than 2 decades of development the results still fall short of what flesh-and-blood operators can achieve.

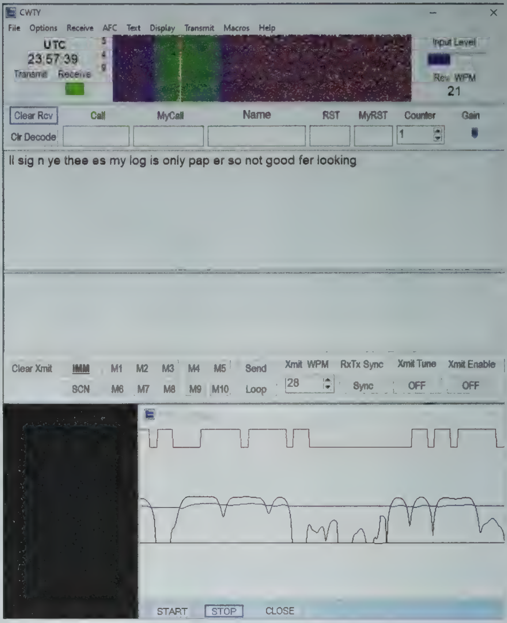
A large portion of the problem is variability, which is a fancy way of saying that different people have different CW sending styles. If everyone sent machine-perfect CW, decoding with software wouldn't be such a challenge. The software would "know" exactly what to expect in terms of the lengths of the *dits* and *dahs*, and the spaces between them. But combine operator variability with the vagaries of noise, fading, and interference and you have a challenging situation to say the least. Once again, human brains handle this very well. For most software decoders, however, it is a bridge too far.

CWTY Decoder

Grant Connell, WD6CNF, has been authoring Windows-based amateur radio software for years. He gives away his creations free of charge at his website, **www.hotamateurprograms.com**. In preparation for an Eclectic Tech podcast interview with Grant last July (Episode 37), I visited his website and discovered a new program: *CWTY Decoder*.

Among his many interests, Grant has been chasing the goal of improving CW decoding software and *CWTY Decoder* is the latest result. In this application, he attempts to expand on the idea of software that "learns" as it decodes, trying to compensate for CW sending that deviates from perfect, and dealing with noise and everything else at the same time.

I gave *CWTY Decoder* a try and the results were impressive. The software locks onto signals quickly and begins tracking variations in the operator's sending style, learning and adapting as it goes. It can display the signal as an audio spectrum, or you can switch to a waterfall display. Figure 1 shows an optional window that compares the audio signal pluses with what the software is decoding, and the timing differences between the two.



UTC 23:57:39

Rcv WPM 21

Counter 1

Il sig n ye thee es my log is only pap er so not good fer looking

Xmit WPM 28

RxTx Sync: Sync

Xmit Tune: OFF

Xmit Enable: OFF

Figure 1 — *CWTY Decoder* with the waterfall display enabled. For this view, the Time Line Display has also been activated to compare the received signal with the application response.

Soon after loading the software, I ran into a person on 20 meters sending rather badly with a bug. Did *CWTY Decoder* perform magic and render a perfect result from the mangled Morse? No, but it at least printed lines of text that were mostly comprehensible, enough that one could get the gist of what was being sent. Better fists produced much better results, of course.

CWTY Decoder can also send as well as receive. You can type into the transmit window or use any of the programmable macro buttons. Interestingly, Grant took the additional step of including the ability to send a number of rarely encountered characters such as @, #, and parentheses. Assuming the person on the receiving end recognized the characters, this could be a helpful feature.

CWTY Decoder is still no match for a seasoned CW operator, but Grant has clearly advanced the CW-decoding art. If you're curious, it costs nothing to try.

The First Activation of Antsell Rock

David Wise, KM3A

One of the many things I enjoy about ham radio is that there are many different aspects of the hobby, so just about everyone can enjoy it. I discovered my interest in radio in 2019, when I activated my first summit with Summits on the Air (SOTA). This program encourages portable operation in mountainous areas around the world.

My first SOTA activation involved driving to the top of a 930-foot hill and walking several hundred feet to set up a Yaesu FT-817 and a magnetic loop antenna. I made five contacts on 20-meter SSB, with operators in Washington, Kansas, Oklahoma, and Louisiana. This might not seem like much to a seasoned ham, but it was incredibly exciting for a begin-ner like me. It was my first test of HF, QRP, and SOTA, and I was im-pressed that I could communicate that far outside of California with only 5 W and no other infrastructure.

Seeking Adventure

As I continued my quest for exciting SOTA activations, my skills progressed and I improved my portable station. Through repeat contacts and social media, I met Scott Lindquist, N0OI, who shared a love of SOTA. He had 33 years of experience in the hobby and ultimately became my mentor. We both live in southern California, approximately 1½ hours driving distance from each other.

In search of adventure, a novice ham and his mentor were the first to activate this challenging summit for Summits on the Air.

David Wise, KM3A, holding the SOTA flag at the top of Antsell Rock.

After activating several summits together, we started looking at various maps in an attempt to locate summits that had never been activated before. One mountain stood out to both of us — Antsell Rock in the San Jacinto Wilderness. Apache Peak (to the east) and Tahquitz Peak (to the west) had been activated numerous times, but Antsell Rock had never been activated. In my research, I found that prior mountaineers claimed the peak was the "most difficult peak in the Desert Divide" (a major ridge system in the southern part of the San Jacinto Mountains) and that it was "a high jagged ridge" that involved a difficult Yosemite

◀Scott Lindquist, N0OI, ascends the YDS Class 4 face of Antsell Rock in the final stretch toward SOTA Summit W6/CT-248.

Decimal System (YDS) Class 4 climb over several exposed areas. Because Scott and I had climbing backgrounds and were familiar with mountaineering and the use of ropes, we decided to attempt an activation of Antsell Rock.

Activating a New Summit

With the aid of a topographical map, Scott and I were able to navigate to the Pacific Crest Trail (PCT) via a saddle between Antsell Rock and Apache Peak. We followed the PCT for a short distance before needing to climb a steep gully that was approximately 700 – 800 vertical feet. After that, we were faced with some large boulders and an exposed climbing wall, which didn't require any ropes, but we needed to use both hands and feet to maneuver through it.

We were thrilled when we reached the summit, and our excitement was elevated by the stunning views of the surrounding San Jacinto Wilderness. While there had been other expeditions that successfully summited Antsell Rock, none of them had activated the peak for SOTA. Scott and I set up our antenna systems and began calling CQ.

Our expedition totaled 26 contacts on CW, SSB, and FM. Rather than returning the way we came, we decided to rappel down several canyons. Although this made for a quick initial descent, we were forced to bushwhack for a bit, which resulted in minor abrasions and cuts. Upon returning to our car, we both agreed this expedition was probably the best activation either of us had ever done.

Conclusion

Even though this particular trip didn't require a stamp in a passport, a rare grid, or a DX contact, for us it was truly extraordinary. With Antsell Rock now behind us, the quest continues. More exciting adventures, stories, contacts, and SOTA summits await, and I'm eager for the experiences they'll bring.

All photos by the author.

David Wise, KM3A, currently works as a Financial Crimes Investigator for Orange County in California and is a US Marine Corps veteran. He enjoys the outdoors and primarily operates CW and QRP portable. David can be reached at **km3a@arrl.net**.

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The Beverage Antenna, 100 Years Later

Still relevant for its noise-rejection abilities, the Beverage will become more important during Solar Cycle 25 as increasing sunspot activity leads to weaker signals on 160 and 80 meters.

CYCLE 25

Ward Silver, NØAX, and
Frank Donovan, W3LPL

On June 7, 1921, Harold Beverage, W2BML, (previously 2BML) obtained his first patent for his radio receiving system. Back then, as they do now, operators struggled to hear signals through the atmospheric static that grew stronger as the frequency dropped. The VLF-through-MF spectrum had very high noise levels that overloaded receivers and made consistent reception very difficult, particularly in the summer months.

Beverage's main discovery was that a long horizontal wire (known to have a bidirectional pattern) could be made unidirectional by keeping it close to the ground and terminating one end of the wire with a resistor. When the wire was aimed at the transmitting station, this had the effect of rejecting noise and interference from other directions, which increased the signal-to-noise ratio (SNR).

A Basic System

The basic Beverage antenna system is shown in Figure 1. The antenna needs to be close to the ground (as opposed to being high in the air) and works best over a ground area with medium-to-poor conductivity. The trade-off is length — Beverages need to be at least ¾ λ long to provide effective noise rejection.

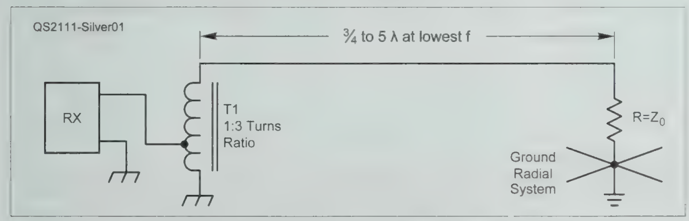

Figure 1 — A simple one-wire Beverage antenna with a resistive termination and a 9:1 impedance transformer provides a good match to 50 Ω coaxial cable.

Wave Front Tilt

A radio wave is an electromagnetic field (EMF) with an electric (E) and magnetic field strength (H) component at right angles. An EMF induces voltage and current in every conductor it encounters. How much voltage and current depends on the orientation of the EMF, with respect to the antenna. As a radio wave arrives from the ionosphere, its vertically polarized electric field component (E field) is tilted forward, as shown in Figure 2. Wave front tilt results from being reflected by the ionosphere. Higher arrival angles increase the tilt.

Figure 2 shows why tilt is important. For the wave to induce a voltage in the antenna, the E field must at least partially align with the antenna. There won't be any voltage if the wave front arrives with a perfectly vertical E field. When the E field is tilted, however slightly, it becomes partially parallel to the antenna. The vertical portion of the tilted E field doesn't create voltage in the antenna, but the horizontal portion does. The result is induced voltage along the entire length of the antenna.

Vertical vs. Horizontal Polarization

Figure 2 shows a vertically polarized E field. A horizontally polarized E field that's parallel and close to Earth is severely attenuated by ground losses. Furthermore, if arriving along the antenna, the E field is at a right angle to the antenna and can't induce voltage in it. That means the Beverage antenna is most sensitive to vertically polarized signals arriving in line with the antenna. (Regardless of a signal's original transmitted polarization, ionospheric propagation always causes polarization rotation, known as Faraday rotation, so the sky-wave signal arrives with a mix of vertical and horizontal polarization.)

The Side and Top

Even if tilted, the vertically polarized E field of signals arriving broadside to the antenna is at a right angle to the antenna and can't induce voltage. Horizontally polarized signals arriving broadside to the antenna have an E field parallel to the antenna, but don't result in strong received signals.

While the vertically polarized E field of a sky-wave signal is perpendicular or tilted with respect to Earth, the horizontally polarized E field is always parallel to Earth. When a horizontal E field is very close to Earth (much less than ¼ λ), it's significantly attenuated by ground conductivity and can't induce much voltage into the antenna.

When sky-wave signals arrive from nearly overhead, both horizontally and vertically polarized E fields are parallel to Earth. They are severely attenuated when close to Earth, before inducing a voltage into the antenna.

Front and Back

The Beverage antenna develops a main forward beam because wave fronts arriving at angles offset from the antenna induce progressively less voltage into it as the angle increases.

Figure 3 shows the Beverage antenna accepting signals from the "front" and rejecting them from the "back." If the right-hand end of the antenna in the figure is left open-circuited, a signal from the back reflects off the end of the wire, just like in an open-ended transmission line. The signal then returns to the feed point, diminished by a small amount of attenuation from the lossy ground below the wire. This unterminated, bidirectional Beverage receives signals from the "front" and slightly less from the "back."

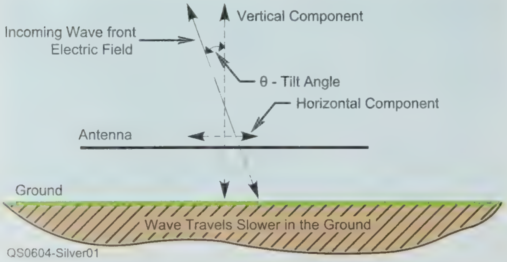

Figure 2 — Incoming signal wave fronts tilt at ground level, due to reflection in the ionosphere and the effects of ground.

If the antenna is terminated with a resistance approximately matching its characteristic impedance, the undesired signal is absorbed at the end of the antenna and not reflected to the feed point. We now have an antenna that attenuates signals in all directions, except from the direction of its terminating resistance. Figure 4 shows the resulting pattern for 160-meter Beverages that are 1 λ (545 feet) and 2 λ (990 feet) long.

Traveling-Wave Antennas

The Beverage antenna is a traveling-wave antenna because it never has standing waves from reflections from the ends of the wire. As a result, it's also non-resonant, and the antenna dimensions aren't required to be a specific fraction or multiple of the signal wavelength. Beverages work well over a fairly wide frequency range where they're between about ¾ and 5 λ long, with good performance around 1 to 2 λ.

Transmission Line

The Beverage antenna has a characteristic impedance and not a feed-point impedance. Like a dipole antenna, current in the Beverage's horizontal wire creates an electrical reflection or image on the ground below it. The current in the wire and its image create an unbalanced transmission line with a characteristic impedance. If this Beverage transmission line is terminated with that same impedance, any signals flowing toward the termination are absorbed, as with any other transmission line. Most Beverages have a characteristic impedance of about

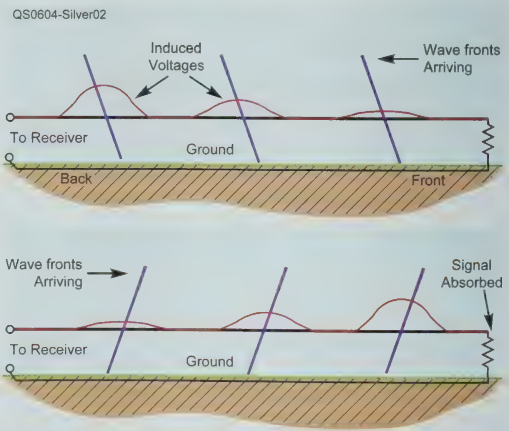

Figure 3 — Voltage waves build up along the antenna and are either transferred to a feed line or absorbed by a terminating resistance.

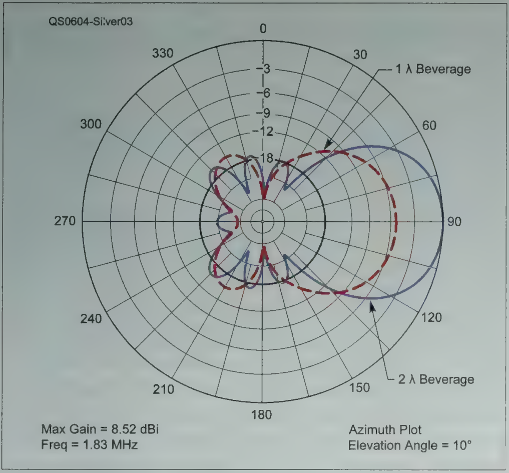

Figure 4 — Radiation patterns for a 1 and 2 λ Beverage antenna. Both antennas have a broad forward lobe and good rejection of signals from the sides and back.

500 Ω. The exact value is relatively unimportant to the performance of the antenna.

Ground Conductivity

Ground conductivity has a big effect on Beverage performance. Lossy ground enhances its performance, but high ground conductivity (especially salt water) severely degrades it. The horizontally polarized E field and tilted vertically polarized E field that induce voltage into the antenna when it's installed over lossy ground are shorted out. Unlike transmitting antennas, the Beverage requires medium or poor ground conductivity to work well.

Building a Basic Beverage

Figure 1 shows a basic Beverage antenna. Any sturdy wire will do (insulated or bare), as long as it's strong enough under the necessary tension. Transformers can be purchased from various sources, or you can wind your own. Tom Rauch, W8JI, has published an informative website on constructing Beverage antennas at **https://new.w8ji.com/beverage-antenna-construction**.

The full benefits of a Beverage antenna begin to appear when the length reaches about 1 λ, but any length above about ½ λ will have some useful directivity (see Table 1). Consider that a Beverage antenna that's 1 λ long at 160 meters will be 2 λ on 80 meters and 4 λ on 40 meters. The antenna can be used on all of these frequencies. Longer Beverages develop a progressively narrower pattern and better interference suppression outside the narrower beam. With a length above 5 λ, sensitivity begins to decline because voltages and currents induced by the tilted wave front start interfering with voltages and currents traveling along the antenna to the feed point.

Table 1 — Recommended Beverage Lengths

Band	Length
160 meters	500 – 1,200 feet
80 meters	300 – 600 feet
40 meters	200 – 500 feet

Speaking from experience, the Beverage wire should be high enough that animals don't run into it. Typical heights range about 6 – 10 feet. The wire should have insulated support at about every 50 feet, but this isn't critical. Electrical fence insulators work well and can be nailed to wooden posts or trees.

The antenna isn't particularly sensitive to small variations in height above ground. Like small "wrinkles" in a two-wire feed line, unless the variations exceed about 0.1 λ, which is about 50 feet at 160 meters, they'll have little effect. Small detours around or over non-conductive obstructions also have little effect.

By using separate feed lines at each end or by using relays to switch between a terminating resistor and a transformer and feed line, signals can be received from either direction. You can also build a two-wire Beverage that can receive from either direction through a single feed line, as described in *The ARRL Antenna Book for Radio Communications* (**www.arrl.org/arrl-antenna-book**) or *ON4UN's Low-Band DXing* by John Devoldere, ON4UN (SK).

Ward Silver, N0AX, has been licensed since 1972. He is Lead Editor of *The ARRL Handbook* and *The ARRL Antenna Book*, and is the author of all three editions of the *ARRL Ham Radio License Manual* and study guides. He released the well-received *Grounding and Bonding for the Radio Amateur* in 2017 and recently authored the third edition of *Ham Radio for Dummies*. Ward can be reached at **n0ax@arrl.org**.

Frank Donovan, W3LPL, began his ham radio journey at 12 years old, during the W1OP/1 Providence Radio Association 1959 Field Day. His multioperator, multitransmitter DX contest teams have made more than one million DX contacts in CQWW and ARRL DX contests. He retired 10 years ago as a Chief Engineer at General Dynamics, after a 45-year career in electronics and systems engineering. Frank can be reached at **donovanf@erols.com**.

For updates to this article, see the *QST* Feedback page at www.arrl.org/feedback.

VOTE
If you enjoyed this article, cast your vote at www.arrl.org/cover-plaque-poll

ARRL Board Returns to In-Person Meeting for Second 2021 Session

During the July meeting, the ARRL Board of Directors adopted a licensing grant program for young amateurs, created a new committee, and conferred awards to deserving applicants.

With the COVID-19 travel and gathering restrictions decreasing, the ARRL Board of Directors met in person on July 16 – 17 in Windsor, Connecticut, for the first time since January 2020 (the Board and Executive Committee had been meeting in virtual sessions since then). During this meeting, ARRL formally endorsed a proposed "Youth Licensing Grant Program," which asks ARRL to cover the $35 application fee for ham radio license candidates younger than 18 years of age. The FCC isn't expected to implement the new application fee schedule until 2022.

The concept behind the program was first raised by ARRL Southeastern Division Director Mickey Baker, N4MB, at the Board's annual meeting in January. An ad hoc committee review subsequently expanded the scope of the original motion.

The program goals include expanding the reservoir of trained operators, technicians, and electronics experts within the amateur radio community, and removing a financial obstacle to young people who wish to acquire an amateur radio license. This program aims to help encourage careers in science, technology, engineering, and mathematics.

Under the program, ARRL would cover a one-time $35 application fee for each qualified candidate who passes one or more amateur radio exams taken on the same day at a single examination session. Tests would have to be administered by a Volunteer Examiner (VE) team working under the auspices of the ARRL Volunteer Examiner Coordinator (VEC). Qualified candidates would pay ARRL VEC® a reduced exam session fee of $5.

The new program would also "enhance ARRL's position as the leader in volunteer testing," the Board motion said. "The Board believes that the recruitment and training of young amateur radio operators is a necessary and proper mission of ARRL, and that subsidization of the $35 fee will reduce the number of new amateurs that otherwise would be lost from these groups."

Staff at ARRL Headquarters would determine the method of qualifying applicants, giving VE teams flexibility to determine whether a candidate is eligible for reimbursement in the absence of documented proof. The new program would initially serve up to 1,000 new license applicants who are under the age of 18.

The motion gave ARRL staff "complete latitude" to determine how payment is delivered to the FCC or how to reimburse eligible applicants. The program length is

The ARRL Board of Directors met on July 16 – 17 in Windsor, Connecticut, for its second meeting of 2021. [Michelle Patnode, W3MVP, photo]

ARRL President Rick Roderick, K5UR, and CEO David Minster, NA2AA. [Michelle Patnode, W3MVP, photo]

indefinite — it may be renewed or terminated by the ARRL Administration and Finance Committee or the Board of Directors.

New Emergency Communications and Field Services Committee

At the July meeting, the ARRL Board approved changes to the By-Laws, creating a third standing committee that joins the existing Administration and Finance Committee, as well as the Programs and Services Committee. The charter of the new Emergency Communications and Field Services Committee (EC-FSC) is to develop and recommend new or modified Board policies and programs for emergency communications through the Amateur Radio Emergency Service® (ARES®) and National Traffic System (NTS™).

The committee will also offer enhanced support for its Field Organization leadership volunteers, including Section Managers, and an increased focus on ARRL Affiliated Clubs. Furthermore, the EC-FSC will provide guidance to the CEO regarding translating Board policies into prioritized tasking, funding, and staffing of programs, services, and training in support of amateur radio emergency communications, field organization volunteers, and recruitment and retention of new and existing members through assistance to Affiliated and Special Service Clubs. Additionally, the EC-FSC will be responsible for monitoring and assessing trends in emergency communications technology and participant skills worldwide, and for identifying best practices for voluntary emergency communications provided by ARES and NTS, while coordinating and cooperating with other amateur radio national societies, as appropriate.

Awards Conferred

Doug DeMaw, W1FB, Technical Excellence Award

Steve Franke, K9AN; Bill Somerville, G4WJS, and Joe Taylor, K1JT, received the ARRL Doug DeMaw, W1FB, Technical Excellence Award for their July/August 2020 *QEX* article, "The FT4 and FT8 Communication Protocols." The DeMaw Award honors the author of an article or article series in ARRL periodicals for the past year, which possesses the highest degree of technical merit.

Philip J. McGan Memorial Silver Antenna Award

John Levo, W8KIW, of Hillsboro, Ohio, was designated as the recipient of the 2021 ARRL Philip J. McGan Memorial Silver Antenna Award. This award honors a Public Information Officer who successfully promotes all aspects of amateur radio that enhance the understanding of amateur radio's contributions to education, public safety, and recreation. The Board said that over time, Levo's efforts have captured "the many avenues of opportunities of amateur radio as a hobby, an education tool, and a service for public safety."

Technical Service Award

The 2021 ARRL Technical Service Award recipient is James Baxter, K0UA, of Branson, Missouri. The Board said that Baxter "exemplifies the spirit of this award due to his diligent work assisting hundreds of hams get on the air [*sic*], particularly with FT8, and by spending countless hours on web sessions with them to work out their configuration issues, show them best practices, and to help track down RFI issues."

Technical Innovation Award

The Board bestowed the 2021 ARRL Technical Innovation Award on Steve Haynal, KF7O; Wojciech Kaczmarski, SP5WWP, and Roger Clark, VK3KYY. Haynal was cited as the driving force behind the Hermes-Lite 5 W HF software-defined radio (SDR) transceiver, which is a fully open-source hardware and software project. Kaczmarski was recognized for developing the open-source digital radio communication protocol M17, which led to the development of DROID-Star (an Android application) by Doug McLain, AD8DP. Clark was cited for spearheading a successful effort to augment a low-cost handheld radio for use by visually impaired operators, significantly lowering the cost of entry for such amateurs.

Herb S. Brier Instructor of the Year Award

The Board awarded the 2021 ARRL Herb S. Brier Instructor of the Year Award to David Ritter, ND4MR, of North Wilkesboro, North Carolina. ARRL sponsors this award in conjunction with the Lake County Indiana Amateur Radio Club in Brier's memory, to recognize superior amateur radio instruction and recruitment. An ARRL member for nearly 40 years, Ritter is an ARRL registered license instructor and a full-time faculty member at Wilkes Community College in Wilkesboro, North Carolina, where he's been the lead (and sole) Technician licensing course instructor since 2010.

Other Business

In other business at the Board's July meeting, ARRL Treasurer Rick Niswander, K7GM, reported that ARRL's investment portfolio recorded a total return of $1.377 million for the second quarter.

Chief Financial Officer Diane Middleton, W2DLM, reported that ARRL continues to have a financially strong balance sheet with current total assets of $42 million, generating larger-than-expected gain from operations through June 30. Total revenues were greater than forecast, while expenses were lower than forecast.

Chief Executive Officer David Minster, NA2AA, told the Board about an exponential return to "normalcy" at ARRL Headquarters. Minster also touched upon the pending implementation of the cloud-based association management solution, Personify360.

The Board authorized ARRL President Rick Roderick, K5UR, to create a committee to search for a new ARRL Treasurer to present to the Board of Directors for their approval.

The Hiram Percy Maxim Award

Increasing the interest and participation in amateur radio of those younger than the age of 21 remains a primary effort of ARRL. Underscoring that focus is ARRL's annual bestowing of its premier award, the Hiram Percy Maxim Memorial Award, on a young member whose contributions to both amateur radio and their local community embody the ideals of the Amateur Radio Service.

The recipient of the 2021 Hiram Percy Maxim Memorial Award is Katherine M. Forson, KT5KMF, of Plano, Texas. A Technician in 2013 at the age of 9, a General in 2017, and an Amateur Extra in 2018, Forson's enthusiasm resulted in her appointment as the ARRL North Texas (NTX) Section Youth Coordinator in 2019.

She's an active member of the Plano Amateur Radio Klub and Collin County Radio Amateur Civil Emergency Service (RACES), and is a trained National Weather Service (NWS) SKYWARN® Storm Spotter. She has been profiled in the *QST* "Member Spotlight" column, participates as an amateur radio operator in public service events such as the Plano Balloon Festival, and is currently working with several other young female hams in the ARRL NTX Section to help build a female-friendly area of the Section's website.

When not on the radio, Forson is active in her school and community. A senior at Plano West Senior High School, she's a member of the National Honor Society, the Spanish National Honor Society (Sociedad Honoraria Hispánica), and the high school band. She won second place in the Dallas Regional Science and Engineering Fair and placed second in the physics and astronomy category at the Texas State Science & Engineering Fair. She serves as a children's lector at her church, and is a Visiting Nurse Association (VNA) Meals on Wheels volunteer for Dallas County residents.

The Hiram Percy Maxim Memorial Award consists of a $1,500 cash award and an engraved plaque. West Gulf Division Director John Robert Stratton, N5AUS, and NTX Section Manager Steven Smith, KG5VK, will present Forson with her award at an upcoming meeting of the Plano Amateur Radio Klub.

ARRL Seeks Treasurer

After 10 years of distinguished service to ARRL as its volunteer Treasurer, Frederick "Rick" Niswander, K7GM, has decided to step down when his current term expires in January 2022. ARRL is seeking qualified candidates from among its membership. The Board of Directors elects the Treasurer and other officers at its Annual Meeting in even-numbered years.

The Treasurer is a non-voting member of the Board of Directors and must be a licensed radio amateur and a full member of ARRL for 4 continuous years prior to nomination. The ARRL By-Laws state that in consultation with and subject to the general supervision of the Administration and Finance Committee, the role of the Treasurer is to:

♦Provide for the investment and reinvestment of the surplus funds of the League in any bonds, stocks, or other securities as would be selected by a trustee with the care of a prudent investor.

♦Provide reports to and attend all regular meetings of the Board of Directors.

♦Serve as a member of the Administration and Finance Committee and, if assigned, subcommittees of the Board or Administration and Finance Committee.

The position is unpaid; however, necessary expenses, including travel to meetings, are reimbursable. For further information, please see the full position description at **arrl.org/treasurerposition**.

A search committee has been established to recommend one or more candidates for Treasurer to the Board. Qualified members are invited to submit a statement of interest and qualifications via email to **treasurersearch@arrl.org**. The deadline is November 12, 2021.

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Rick Lindquist, WW1ME, ww1me@arrl.org

Happenings

Three-Way Races for Director Under Way in New England and Roanoke Divisions

ARRL members in the New England and Roanoke Divisions are choosing among three candidates for Director, including incumbents, in each Division. These are the only contested races in this year's election cycle for Director and Vice Director.

In the New England Division, the candidates for Director are the incumbent, Fred Hopengarten, K1VR, of Lincoln, Massachusetts; Tom Frenaye, K1KI, of West Suffield, Connecticut, and Fred Kemmerer, AB1OC, of Hollis, New Hampshire.

New England Division Vice Director Phil Temples, K9HI, of Watertown, Massachusetts, was uncontested and has been declared elected.

In the Roanoke Division, the candidates for Director are the incumbent, George "Bud" Hippisley, W2RU, of Penhook, Virginia, and challengers James Boehner, N2ZZ, of Aiken, South Carolina, and Marvin Hoffman, WA4NC, of Boone, North Carolina.

No one challenged Roanoke Division Vice Director Bill Morine, N2COP, of Wilmington, North Carolina, and he has been declared elected for a new term.

Incumbent Directors and Vice Directors in the ARRL Central, Hudson, and Northwestern Divisions also had no challengers and have been declared elected.

Ballots will be mailed no later than October 1 to ARRL members who are in good standing as of September 10, 2021. Completed ballots must be received at the designated PO Box in the envelope provided by noon Eastern Time Friday, November 19, 2021.

Utah Amateur Radio Club Receives Nearly $18,000 Grant to Introduce and Engage Youth

The Bridgerland Amateur Radio Club (BARC) in northern Utah has received a nearly $18,000 grant from the non-profit Amateur Radio Digital Communications (ARDC) to fund the club's initiatives to engage and educate youth in amateur radio through hands-on space science activities.

"This grant and our Bridgerland Amateur Radio Club demonstrate the important role amateur radio can play in furthering STEM education, which is critical to continuing Utah's high-tech economy," said Utah Section Manager Pat Malan, N7PAT, who came into office on July 1. Malan said prime movers behind the grant initiative included Jason Peterson, K7EM; BARC President Ted McArthur, AC7II, and BARC Treasurer Kevin Reeve, N7RXE — the Utah Section Youth Coordinator.

In July 2019, ARDC announced that it would use the proceeds from its sale of some 4 million unused consecutive Amateur Packet Radio Network (AMPRNet) internet addresses to fund its operations and to establish a program of grants and scholarships to support communications and networking research, with a strong emphasis on amateur radio.

BARC has laid out an 18-month timeline of proposed activities, which would include an Amateur Radio on the International Space Station (ARISS) contact between students in a local school and a member of the ISS crew, hands-on workshops to build and launch a high-altitude balloon and amateur radio payload, and youth-oriented hands-on operating events.

"Where local schools do not have the equipment to make this a possibility, the Bridgerland Amateur Radio Club is prepared to set up and maintain a portable ground station and provide the expertise to help [schools] make ISS contacts," the announcement said.

A component of this initiative would include training local radio amateurs to use the ground station equipment to prepare them to mentor students and apply the necessary skills to help run the activities.

ARDC has said that it intends to award "a total of several million dollars in grants of varied amounts" to qualified beneficiaries, to be used in accordance with ARDC's mission. Numerous amateur radio organizations and projects have already benefited from ARDC's largesse. In 2020, the ARRL Foundation received a $200,000 scholarship-matching grant.

FCC Grants 60-Day Waiver of Part 97 Data Rate Rules for Hurricane Relief Traffic

In an August 30 *Order* (available at **https://docs.fcc.gov/public/attachments/DA-21-1075A1.pdf**), the FCC granted a temporary waiver sought by ARRL to facilitate relief communications related to Hurricane Ida. The waiver also applies to relief communications directly related to any future hurricane over the next 60 days. The waiver permits radio amateurs handling hurricane relief communications on HF to use any protocol that would comply with the FCC's rules but for the symbol rate limits.

In its request, ARRL said that Section 97.307(f) of the FCC's Amateur Service rules prevents the use on HF of certain protocols capable of higher data rate emissions that many amateur stations are capable of using while active in emergency communications preparedness. ARRL asserted that higher data rates can be critical to timely transmission of relief communications, such as lists of needed and distributed supplies.

The Commission noted that a waiver was necessary because Section 97.307(f) limits the symbol rate at which the carrier waveform amplitude, frequency, and/or phase is varied to transmit information for HF RTTY/data transmissions to 300 baud for frequencies below 28 MHz (except on 60 meters), and to 1,200 baud on 10 meters.

"The digital code used to encode the signal being transmitted must be one of the codes specified in section 97.309(a) of the FCC's rules, but an amateur station transmitting a RTTY or data emission using one of the specified digital codes may use any technique whose technical characteristics have been publicly documented, such as CLOVER, G-TOR, or PACTOR," the FCC said.

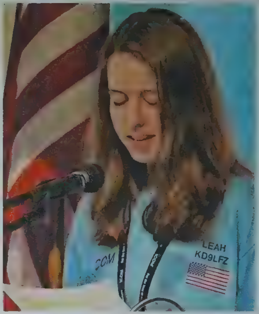
The waiver is limited to amateur radio operators in the US and its territories using publicly documented data protocols that are compatible with FCC rules, with the exception of the data rate limit waived here, for those directly involved with HF hurricane relief communications."

Youth on the Air Campers Enjoy Successful ISS Contact, Other Activities

Young radio amateurs at the first Youth on the Air (YOTA) camp in the Americas enjoyed a variety of activities in mid-July. Campers had fun while operating special event station W8Y and launching a balloon carrying a ham radio payload (reaching approximately 100,000 feet), among other activities.

Several of the approximately two dozen campers got to ask questions of ISS Crew Member Akihiko Hoshide, KE5DNI, during an Amateur Radio on the International Space Station (ARISS) contact. Responding to a query posed by Graham Rousseau, KO4FJK, Hoshide said the most interesting things he's seen from space included flying through an aurora and looking down at "shooting stars" from the ISS. He also said the ISS crew was able to view a partial lunar eclipse from space.

Hoshide answered another camper's question, saying that individual crew members may get on the ISS ham radio every couple of weeks or so, or as the opportunity arises.


YOTA camper Leah McGrane, KD9LFZ, was one of the campers chosen to ask Astronaut Akihiko Hoshide, KE5DNI, a question during an ARISS contact.

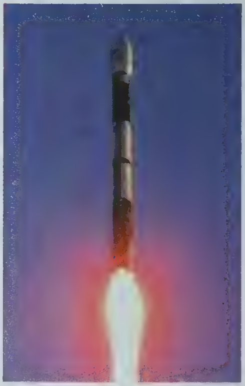
Camp Director Neil Rapp, WB9VPG, said he hopes to replicate the pilot camp experience over multiple locations in the years to come.

The camp's opening observance featured keynote speaker Tim Duffy, K3LR, who told the campers, "Amateur radio is the best hobby in the world."

GENESIS Satellites Among Payloads Lost in Launch Failure

The GENESIS-L and GENESIS-N ham radio satellites were among several carrying amateur radio payloads lost following the failure of the Firefly Alpha rocket during its first launch on September 2 from the Vandenberg Space Force Base in California. This was sad news for AMSAT-EA (Spain), as GENESIS-L and GENESIS-N were the first satellites they had built themselves.

According to the AMSAT-EA website, the GENESIS satellites were destroyed after the Firefly Alpha vehicle presented an anomaly as it hit a velocity of Mach 1 and reached Max Q, a point of maximum aerodynamic pressure on the vehicle.


The launch of the Firefly Alpha rocket.

GENESIS-L and GENESIS-N were to conduct a series of telecommunications-related experiments, while a ground-station analysis of the received signals would try to attain Doppler variations in order to perform orbit determination and satellite identification from radio amateur stations around the world. Several other satellites carrying amateur radio payloads were also lost.

Nathaniel Frissell, W2NAF, Awarded $481,260 NASA Research Grant

Ham Radio Science Citizen Investigation (HamSCI) founder Nathaniel Frissell, W2NAF — an assistant professor in The University of Scranton's Physics and Engineering Department — has been awarded a $481,260 grant through the NASA Space Weather Applications Operations Phase II Research Program. Frissell will serve as principal investigator for a research project entitled, "Enabling Space Weather Research with Global Scale Amateur Radio Datasets." He'll collaborate with Philip Erickson, W1PJE, of the Massachusetts Institute of Technology (MIT) Haystack Observatory and Bill Engelke, AB4EJ, at The University of Alabama.

Nathaniel Frissell, W2NAF

"This grant includes significant funding for participation of Scranton undergraduate students in this research, as well as support for new computation resources," Frissell said. He explained that the grant will fund "the development of an empirical model for the prediction of traveling ionospheric disturbances (TIDs) in high-frequency radio communications while investigating the geophysical drivers of these disturbances." The grant will cover 2 years of work.

Frissell said that the predictive, empirical TID models will be developed using data collected by the Reverse Beacon Network, WSPR, and PSKReporter.

This new NASA award complements a 5-year National Science Foundation (NSF) grant of more than $616,000 that Frissell received in 2020. That investigation aims to understand the source of TIDs observed in amateur radio and other scientific datasets.

In 2019, Frissell received a $1.3 million NSF grant to fund a 3-year initiative to measure modulations produced in the Earth's upper atmosphere.

Section Manager Nomination Notice

To all ARRL members in the Eastern New York, Eastern Pennsylvania, Louisiana, North Carolina, Pacific, San Diego, South Dakota, and Virginia Sections. You are hereby solicited for nominating petitions pursuant to an election for Section Manager (SM). Incumbents are listed on page 16 of this issue.

To be valid, a petition must contain the signatures of five or more full ARRL members residing in the Sections concerned. It is advisable to have a few more than five signatures on each petition. A sample nomination form is available on the ARRL website at **www.arrl.org/section-terms-nomination-information**. Nominating petitions may be made by facsimile or electronic transmission of images, provided that upon request by the Field Services Manager, the original documents are received by the manager within 7 days of the request. It is acceptable to submit signatures that have been sent via email or mail under the following guidelines: The petition copies must be made from the original form supplied by ARRL or downloaded from the ARRL website. The form must be exactly the same on both sides (i.e., autobiographical information should appear exactly the same on all copies). All forms/copies must be submitted together.

Candidates may use any of the available electronic signature platforms such as DocuSign, HelloSign, and Signed PDF. Candidates who use an electronic signature platform to be nominated, as described above, do not have to send in original paper copies of the nominating documents. The packet that is sent to ARRL Headquarters must be complete. Multiple files or emails for a single petition will not be accepted.

We suggest the following format:

(Place and Date)

Field Services Manager, ARRL
225 Main St.
Newington, CT 06111

We, the undersigned full members of the ______ ARRL Section of the ______ Division, hereby nominate ______ as candidate for Section Manager of this Section for the next 2-year term of office.

(Signature _____ Call Sign ______ City _____ ZIP ______)

Any candidate for the office of Section Manager must be a resident of the Section, an amateur radio licensee of Technician class or higher, and a full member of ARRL for a continuous term of at least 2 years immediately preceding receipt of a nominating petition. Petitions must be received at Headquarters by 4 PM Eastern Time on December 10, 2021. If more than one member is nominated in a single Section, ballots will be mailed from Headquarters no later than January 3, 2022 to full members of record as of December 10, 2021, which is the closing date for nominations. Returns will be counted on February 22, 2022. Section Managers elected as a result of the above procedure will take office April 1, 2022.

If only one valid petition is received from a Section, that nominee shall be declared elected without opposition for a 2-year term beginning April 1, 2022. If no petitions are received from a Section by the specified closing date, such Section will be resolicited in the April issue of *QST*. A Section Manager elected through the resolicitation will serve a term of 18 months. A Section Manager vacancy occurring between elections is filled through appointment by the Field Services Manager. — *Mike Walters, W8ZY, Field Services Manager*

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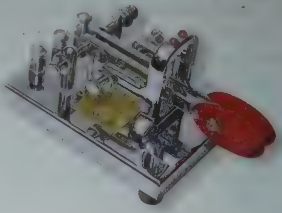

This month, ARRL recognizes merit and progress in Morse code proficiency on the part of the following individuals, who have achieved proficiency at the following rates, in words per minute.

May 2021	
Angelica T. Brewer, KN4SGS	10
James W. Carter, K7IOL	10
Federico Grau, KC3MWD	10
Roger L. Burkhart, N3GE	15
Daniel Lasorso, KD8OFT	15
Bill H. Stephens, NU0Y	15
Joel F. Wagner, III, ND5V	15
Roger L. Burkhart, N3GE	20
Bill H. Stephens, NU0Y	20
William N. Massie, AA8KY	20
Dennis J. Niles, WV7S	20
Paul D. Manoli, KB1NCD	35

June 2021	
David O. Ausley, WB4NCT	10
Russell Calabrese, KR2NZ	10
Harold D. Craft, Jr., AA2J	10
Jere F. McAlister, N5DFW	10
Glenn E. Schnell, KC3LBI	10
Lawrence Schall, KB2MN	15
Thomas J. Warren, K3TW	35

July 2021	
Stephen J. Banko, KI5IIL	10
Bert H. Berrong, WZ5L	10
Bill Durham, KG5ZCI	10
Bruce E. Friedline, N9XAU	10
Roy L. Schmiesing, KT6B	10
Richard J. Guerrera, KB1FGC	25
Richard J. Hubbard, Jr., WF4W	30
Dwight Edward Morrow, VE7BV	30
James B. Elkins, KG4IKQ	35
Johnny L. Welch, Sr., KE6K	35
Christopher G. Pearson, G5VZ	40

August 2021	
Christopher E. Johnson, WB9FXW	10
Charles E. Ruotolo, KA8VYG	10
George A. Stickney, W7BXW	10
Kenneth G. Koenig, KK6XI	15
Donald W. Brown, W0AF	20
Victor Denisov, N6DVS	20
Ronald L. Edwards, KE8NCJ	20
David W. Hibbard, NK0K	20

Congratulations to all the recipients.

November 2021 W1AW Qualifying Runs

W1AW, the Hiram Percy Maxim Memorial Station at ARRL Headquarters in Newington, Connecticut, transmits Morse code Qualifying Runs to assist ham radio operators in increasing and perfecting their proficiency in Morse code. Amateur radio operators can earn a Certificate of Code Proficiency or endorsements by listening to W1AW Qualifying Runs.

November Qualifying Runs will be transmitted by W1AW in Newington, Connecticut at the times shown at 1.802.5, 3.581.5, 7.047.5, 14.047.5, 18.097.5, 21.067.5, 28.067.5, 50.350, and 147.555 MHz. The West Coast Qualifying Runs are scheduled to be transmitted by K9JM on Wednesday, November 17 at 9 PM PST (0500 UTC on November 18) on 3590 and 7047.5 kHz. Unless indicated otherwise, sending speeds are from 10 to 35 WPM.

Amateur radio operators who participate in Qualifying Runs may submit proof of 1 minute of the highest speed they have copied in the hope of qualifying for the Certificate of Code Proficiency, or an endorsement to their existing certificate.

Legibly copy at least 1 minute of text by hand, and mail the sheet to:
W1AW Qualifying Runs, 225 Main St., Newington, CT USA 06111.

Include $10 (check or money order) if this is a submission for your initial Code Proficiency certificate; $7.50 if you are applying for an endorsement (available for speeds up to 40 WPM). Your test will be checked against the actual transmissions to determine if you have qualified.

Members of the North Fulton (Georgia) Amateur Radio League (**https://nfarl.org**) are offering to subsidize the total cost of a Code Proficiency certificate or endorsement submission for any individual age 21 years and younger, and who reside in either the US or Canada. Participants who wish to make use of this offer should indicate on their qualifying run submissions they are age 21 or younger, and certify as such via their signature. Eligible participants are not required to send any fee with their Code Proficiency submissions.

For more information about Qualifying Runs, please visit **www.arrl.org/qualifying-run-schedule**.

For information about how to qualify for the Certificate of Code Proficiency, please visit **www.arrl.org/code-proficiency-certificate**.

W1AW Qualifying Runs — November 2021
(All times are in Eastern Standard Time; Blue indicates Eastern Daylight Time.)

Monday	Tuesday	Wednesday	Thursday	Friday
11/1 4 PM – 2000Z 10 – 35 WPM	**11/2** 7 PM – 2300Z 35 – 10 WPM		**11/4** 10 PM – 0200Z **(11/5 – UTC)** 10 – 40 WPM	**11/5** 9 AM – 1300Z 10 – 35 WPM
	11/9 4 PM – 2100Z 10 – 35 WPM	**11/10** 9 AM – 1400Z 35 – 10 WPM	**Veteran's Day**	**11/12** 10 PM – 0300Z **(11/13 – UTC)** 10 – 35 WPM
	11/16 9 AM – 1400Z 10 – 35 WPM	**11/17** 10 PM – 0300Z **(11/18 – UTC)** 35 – 10 WPM	**11/18** 7 PM – 0000Z **(11/19 – UTC)** 10 – 35 WPM	**11/19** 4 PM – 2100Z 10 – 40 WPM
11/22 10 PM – 0300Z **(11/23 – UTC)** 10 – 40 WPM		**11/24** 9 AM – 1400Z 35 – 10 WPM	**Thanksgiving**	**Thanksgiving**

QST

Contest Season 2021 – 2022

ST Supplement, November 2021
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The National Association for
Amateur Radio®

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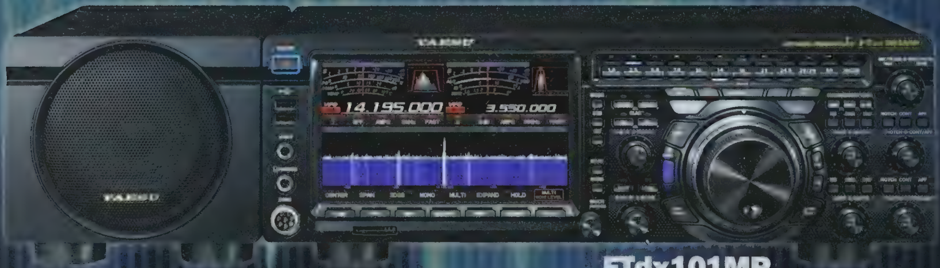

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Contest Calendar

November 2021 – December 2022

This calendar covers the major contests, but there are plenty of others throughout the year. Visit **www.arrl.org/contest-calendar** and **contestcalendar.com** for more contest dates and details.

Nov 2021

6-8	ARRL NOVEMBER SWEEPSTAKES — CW
20-22	ARRL NOVEMBER SWEEPSTAKES — PHONE

Dec 2021

3-5	ARRL 160 METER CONTEST
11-12	ARRL 10 METER CONTEST
12	ARRL & RSGB 160-METER TRANSATLANTIC CENTENARY QSO PARTY
19	ARRL ROOKIE ROUNDUP — CW

Jan 2022

8-9	ARRL RTTY ROUNDUP
15-16	NORTH AMERICAN QSO PARTY — CW
22-23	NORTH AMERICAN QSO PARTY — SSB

Feb 2022

5-6	NORTH AMERICAN SPRINT — CW
12-13	CQ WORLD WIDE WPX — RTTY
14-18	SCHOOL CLUB ROUNDUP
19-20	ARRL INTERNATIONAL DX — CW
26-27	NORTH AMERICAN QSO PARTY — RTTY

Mar 2022

5-6	ARRL INTERNATIONAL DX — SSB
12-13	NORTH AMERICAN SPRINT — RTTY
26-27	CQ WORLD WIDE WPX — SSB

Apr 2022

10	ARRL ROOKIE ROUNDUP — PHONE

May 2022

28-29	CQ WORLD WIDE WPX — CW

Jun 2022

25-26	ARRL FIELD DAY

Jul 2022

9-10	IARU HF WORLD CHAMPIONSHIP
16-17	NORTH AMERICAN QSO PARTY — RTTY

Aug 2022

6-7	NORTH AMERICAN QSO PARTY — CW
20-21	NORTH AMERICAN QSO PARTY — SSB
21	ROOKIE ROUNDUP — RTTY

Sep 2022

24-25	CQ WORLD WIDE DX CONTEST — RTTY

Oct 2022

17-21	SCHOOL CLUB ROUNDUP
29-30	CQ WORLD WIDE DX CONTEST — SSB

Nov 2022

5-7	ARRL NOVEMBER SWEEPSTAKES — CW
19-21	ARRL NOVEMBER SWEEPSTAKES — PHONE
26-27	CQ WORLD WIDE DX CONTEST — CW

Dec 2022

2-4	ARRL 160 METER CONTEST
10-11	ARRL 10 METER CONTEST
18	ARRL ROOKIE ROUNDUP — CW
TBD	ARRL & RSGB TRANSATLANTIC CENTENARY MARATHON

Performance Enhancement Tips

Bud Trench, AA3B, Frankford Radio Club

Here are just a few of the things you can do before, during, and after a contest effort to improve your efficiency and your score.

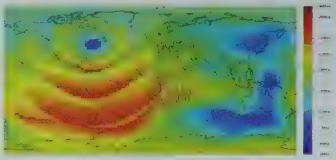
For all Categories

Be active! Short burst contests like the CWops Tests (CWT), state QSO parties, or DX contests sponsored by national organizations are excellent opportunities to practice and experiment, as well as verify station functionality. Your presence in these events improves your recognition of active contester call signs, and promotes recognition of your call in the contest community.

Study your peers or competitors. You can study their public logs to identify their band selections and off times. There are often useful intelligence nuggets in the postings on **https://www.swpc.noaa.gov/**. For CW and RTTY contests, Reverse Beacon Network (RBN) data offers a wealth of information — see **http://www.reversebeacon.net/raw_data/**.

Create goals for the contest. The goals should include challenging QSO and multiplier targets for each band. When setting goals, consider the past performance of yourself and peers, and the impacts of propagation. See “Setting Goals for Your Contest Operation” on the next page for more guidance.

Review propagation predictions and forecasts. Voice of America Coverage Analysis Program (VOACAP) Online Prediction Services available at **https://www.voacap.com/** and the K7RA Solar Update (available in the weekly *ARRL Letter*, **http://www.arrl.org/arrlletter**) are worthy of study prior to a contest. These predictions can be augmented by mining raw RBN data. During the contest, consult the hourly forecasts from the National Oceanic and Atmospheric Administration (NOAA) Space Weather Prediction Center (SWPC, **https://www.swpc.noaa.gov/**).



VOACAP offers customizable propagation tools.

Craft an operating plan that identifies the most productive band (predicted) by hour and flags multiplier-rich openings. Include off-times, sunrise, and sunset.

Maximize your QSO rate by keeping all stored messages (macros and WAV files) to the minimum length needed to convey the required information.

Leverage technology that provides signals visualization. Integrating visualization with rig control and logging software provides powerful capabilities for assessing band activity at a glance, finding run frequencies, or doing rapid search and pounce.

Log on to online scoreboards for motivation and tracking competitor progress. Many participants provide band breakdowns, which gives valuable insight on their progress, and can inform your band selections.

Maximize points per hour (rather than rate) in contests like CQ World Wide WPX or IARU HF World Championship that have different point values per QSO. Avoid prolonged runs of contacts with low QSO point values.

On CW, transmit a bit above or below the frequency of the station you’re calling if that station has multiple callers transmitting on the same frequency.

Track your performance during the contest against goals and/or previous scores. Consulting hourly breakdowns from previous contests can impact your operating decisions for the balance of the contest period.

Critically analyze your results. Document what went well and note opportunities for improvement. Did you make the right band and off-time selections? How did your competitors do? Was there any unexpected propagation? What were your best and worst hours? Are there any faults or intermittent conditions that need to be resolved before the next event?

For Unlimited (Assisted) Category Operations

Set up multiple DX cluster nodes to hedge against a node failure. Configure your contest logging software to allow rapid transitions between nodes.

Consider setting up a second DX cluster application dedicated to displaying only spots of your competitors. This will give you real-time awareness of their presence and band choices.

IT'S HERE!
CYCLE 25
CYCLE 25
GET YOUR GEAR - ARRL.ORG/SHOP

Setting Goals for Your Contest Operation

Bud Trench, AA3B, Frankford Radio Club

This is the technique I used to synthesize overall goals for IARU HF World Championship 2021 and allocate these goals to each band. This technique can readily be applied to other contests.

Start by building a table of results for a peer group, as illustrated in **Table 1**. This information is typically available from contest results articles, score databases provided by the contest's sponsor, or from **3830scores.com** listings.

Table 1. Peer Performance from IARU HF World Championship 2020

SOHP CW IARU Performance Parameters from 2020

Call	Score	Q	M	Qpts	Qpts/Q	Rate	M/Q
AA3B	3060344	3110	296	10339	3.32	130	0.10
W1KM	2631980	2691	260	10123	3.76	112	0.10
VE3JM	2428790	2913	221	10990	3.77	121	0.08
K8AZ	2306739	2227	303	7613	3.42	93	0.14
K1KI	2214576	2421	252	8788	3.63	101	0.10
Average	2528486	2672	266	9571	3.58	111	0.10

Key

SOHP = Single Op High Power

Q = QSOs

M = Multiplier

Qpts = QSO points

Rate = QSOs/hour

Next, analyze the performance by band, as shown in **Table 2**. The key calculation is provided in the Average Allocation row, which is the percentage of total QSOs or multipliers worked on each band.

Table 2. Peer Band Breakdowns from IARU HF World Championship 2020

	160m		80m		40m		20m		15m		10m	
Call	**Q**	**M**	**Q**	**M**	**Q**	**M**	**Q**	**M**	**Q**	**M**	**Q**	**M**
AA3B	41	15	424	54	910	66	1125	80	514	51	96	30
W1KM	68	22	268	42	652	55	1139	69	442	45	122	27
VE3JM	71	11	411	40	593	41	1223	60	536	41	79	28
K8AZ	26	10	244	49	720	73	839	88	322	53	76	30
K1KI	34	20	160	34	792	59	983	66	207	42	245	31
Average	48	16	301	44	733	59	1062	73	404	46	124	29
Average Allocation	2%	6%	11%	17%	27%	22%	40%	27%	15%	17%	5%	11%

The third step is to establish QSO, multiplier, and score targets for the current year.

QSO Target: The QSO Target should consider propagation, station and/or operating enhancements, and stretch goals. I typically use these factors to adjust my average rate from the prior year. In this case, I decided to increase my 2020 rate from 130 to 133 QSOs/hour, resulting in a 2021 QSO Target of 3,193.

Multiplier Target: A starting point for the Multiplier Target is to multiply the QSO Target by a Multiplier / QSO (M/Q) value selected after consideration of Table 1 data. I picked a M/Q ratio of 0.095, which was slightly less than the peer group average resulting in an initial Multiplier Target of 303.

Score Target: The initial Score Target is determined by multiplying the QSO Target by the Multiplier Target by a QSO points / QSO (Qpts/Q) ratio based on the data in **Table 1**. The Qpts/Q ratio I used was 3.35, which was less than the peer group ratio but greater than my 2020 performance. The resulting Score Target calculation for IARU 2021 was 3.2 million points.

Raw goals for each band are next determined by applying the ratios from the Average Allocation row in **Table 2** to the QSO and Multiplier Targets.

Finally, do a qualitative assessment, based on experience and judgement, of all calculated values to finalize the goals. My raw and finalized targets for IARU 2021 are shown in **Table 3**.

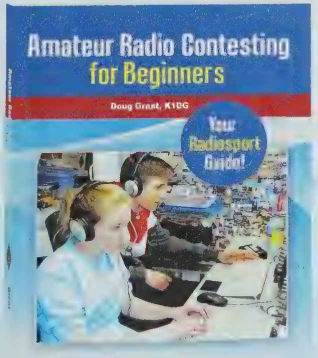
Table 3. AA3B QSO and Multiplier Goals by Band for IARU HF World Championship 2021

	160m		80m		40m		20m		15m		10m		Total	
	Q	M	Q	M	Q	M	Q	M	Q	M	Q	M	Q	M
Raw Band Targets	57	18	360	50	876	67	1269	83	483	52	148	33	3193	303
Final Band Targets	50	15	350	55	900	65	1200	80	550	55	150	35	3200	305

In closing, goal setting improves readiness and creates a competitive advantage. The goals can motivate the operator to make the extra push needed to meet or beat a target. After the contest, a review of performance versus goals is often a useful aid in developing lessons learned for the next year.

Amateur Radio Contesting for Beginners
by Doug Grant, K1DG
offers ideas to get you started in contesting or to build your skills if you're already active.
Three tips from the book to get you started:
- Get on the air as frequently as possible before the contest.
- Talk (or send code) at the same rate of speed as the station you're contacting.
- Use contest logging software to log your contacts.

Order Online at arrl.org/shop



Propagation Tools and Resources for Contesting

Ken Caruso, WO1N, with Andrew Rodland, KC2G, and members of the Yankee Clipper Contest Club (YCCC)

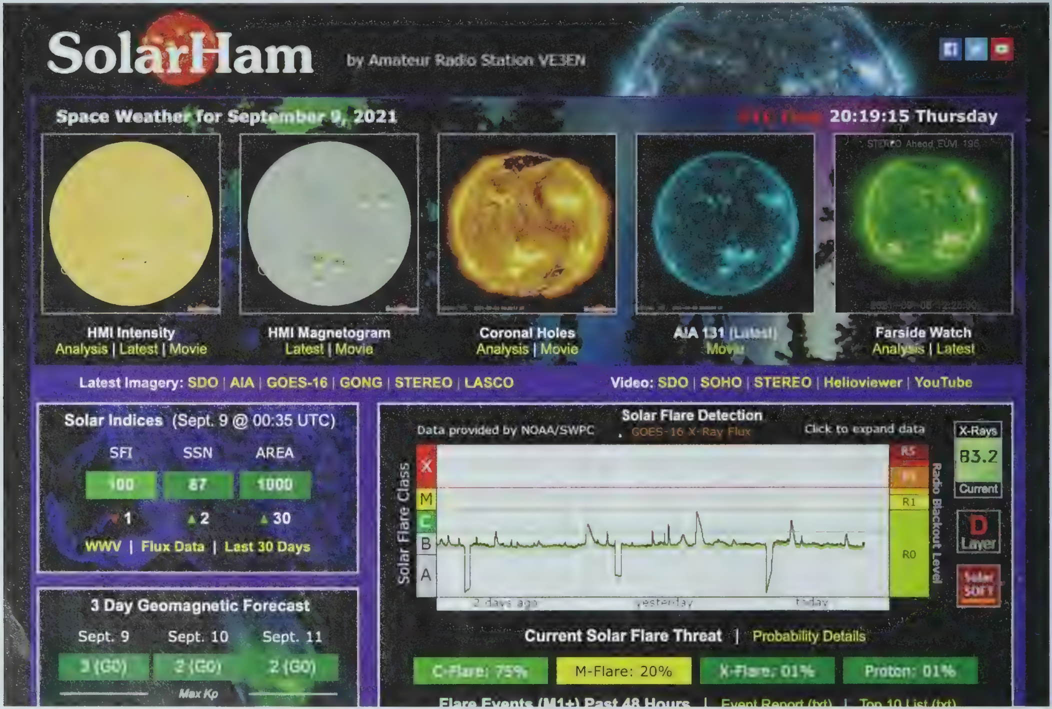
HF propagation predictions provide data that, when analyzed, can help you maximize your rate and multipliers during DX contests. Real-time propagation tools may help you more rapidly adjust to changing conditions during the event.

It is hard to find a substitute for operating experience when it comes to understanding propagation from your home station, especially if you've been operating from your station for multiple solar cycles. Keeping an eye on the basics (sunspot numbers, geomagnetic activity, grayline) and reviewing past logs from prior solar cycles with similar conditions can remind you of any unusual openings.

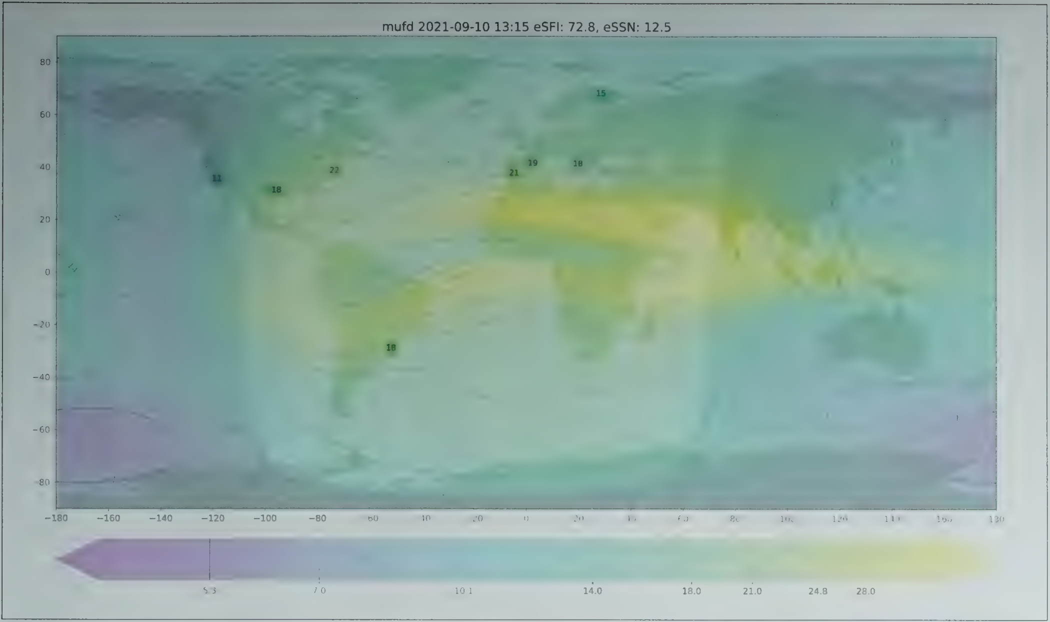
When operating from a new station location (perhaps remotely or on a DXpedition), you might not be familiar with the propagation characteristics from that location. Employing the tools described here before and during the event can help you to develop a sense of what to expect.

Many of these tools are interactive online resources that you can use for planning your contest effort. You can gather data and develop an operating strategy. While identifying major band openings to maximize your rate is important, analysis might reveal secondary paths to help you eke out a rare multiplier or two. In the end, more contacts and more multipliers result in a higher score for you and your contest club.

Other websites that offer real-time data can help you understand the current conditions during a contest, but be aware that using real-time data could land you in the contest's assisted class.


SolarHam
by Amateur Radio Station VE3EN
Space Weather for September 9, 2021
UTC Time 20:19:15 Thursday
HMI Intensity
Analysis | Latest | Movie
HMI Magnetogram
Latest | Movie
Coronal Holes
Analysis | Movie
AIA 131 (Latest)
Movie
Farside Watch
Analysis | Latest
Latest Imagery: SDO | AIA | GOES-16 | GONG | STEREO | LASCO
Video: SDO | SOHO | STEREO | Helioviewer | YouTube
Solar Indices (Sept. 9 @ 00:35 UTC)
SFI
SSN
AREA
100
87
1000
▼1
▲2
▲30
WWV | Flux Data | Last 30 Days
3 Day Geomagnetic Forecast
Sept. 9
Sept. 10
Sept. 11
3 (G0)
2 (G0)
2 (G0)
Max Kp
Solar Flare Detection
Data provided by NOAA/SWPC
GOES-16 X-Ray Flux
Click to expand data
Solar Flare Class
X
M
C
B
A
R5
R1
R0
Radio Blackout Level
2 days ago
yesterday
today
X-Rays
B3.2
Current
D Layer
Solar SOFT
Current Solar Flare Threat | Probability Details
C-Flare: 75%
M-Flare: 20%
X-Flare: 01%
Proton: 01%
Flare Events (M1+) Past 48 Hours | Event Report (txt) | Top 10 List (txt)

The SolarHam site (solarham.net) aggregates data from several sources to create a snapshot of current space weather conditions.



The real-time maps at prop.kc2g.com are based on real-time ionospheric data.

Planning Tools

SolarHam — solarham.net — by VE3EN brings together useful data from NOAA, NASA, Environment Canada and other agencies, with links to the original sources. This site is the total snapshot of the current space weather conditions, an important factor in developing propagation predictions.

VOACAP Online for Ham Radio — voacap.com/hf/ — was put together by Jari Perkiomaki, OH6BG; James Watson, M0DNS, and Juho Juopperi, OH8GLV. It translates the tabular VOACAP predictions from days past into very informative graphical presentations. The site has been recognized for excellence by the YASME Foundation.

Proppy — soundbytes.asia/proppy/ — is an HF propagation prediction website developed by James Watson, M0DNS. Proppy utilizes the ITU's ITURHFPROP application for predictions. Excellent graphical displays of area and point-to-point predictions can be produced. Short Wave Listeners are considered, with a tab focused on International Broadcasters.

Real-Time Monitoring Tools

Real-Time HF Propagation Prediction — hamwaves.com/propagation/en/index.html —maintained by Serge Stroobandt, ON4AA, is a useful presentation of the current HF propagation influencers. Especially useful is the real-time MUF (maximum usable frequency) and OWF (optimum working frequency) information.

PSK Reporter (**pskreporter.info/pskmap.html**) and **WSPRnet** (**wsprnet.org/drupal**) are useful for keeping an eye on what QSOs are really happening right at the moment.

DXMaps.com is likewise useful for viewing QSOs that are happening in real time.

aprs.mennolink.org (worldwide) and **www.propquest.co.uk** (Europe) display VHF path enhancements such as E_s or tropospheric ducting.

prop.kc2g.com/ provides near real-time maps and data describing ionospheric conditions and is recognized as a game-changer for the amateur community by moving from prediction-based analysis, to analysis based on real-time ionospheric data. Data from the network of ionospheric sounders (GIRO) is merged with NOAA Ap estimates to produce global values for foF2, hmF2, MUF, and foE. MUF isolines are estimated and plotted across the globe.

These tools synthesize an astounding array of complex inputs that describe the anticipated or current propagation conditions. You can employ these tools to develop your operating plan, and to identify when to look for rare multipliers or band openings. Armed with real-time data, you can quickly react to the ever-changing conditions experienced during a contest. The net result should be an increase in your contest score from wherever you operate.

Contesting Do’s and Don’ts

by members of the Florida Contest Group

Florida Contest Group
MULTIPLIERS ARE

To someone just starting out, contesting can seem to be the ultimate insider’s sport. Contesters who are at the top of the standings over and over always seem to be in the right place at the right time, and seem to find band openings that mere mortals can only dream of. More importantly, they seldom make the big mistakes that sometimes sink their competitors.

A number of years ago, some of the experienced and accomplished members of the Florida Contest Group distilled their decades of experience into a list of do’s and don’ts that would help all contesters position themselves for success before, during, and after a contest. Even if you apply just one tip out of dozens to your next contest operation, we think it will help your score. Good luck!
— W4WF, K5KG, K1TO, K8NZ, K4XS

Planning Ahead

- Do any necessary antenna work as far in advance as possible.
- Think about your contest strategy in advance.
- Decide on your category.
- Select your power level. Remember to check whether if the contest rules include a power multiplier for QRP or LP, and whether your power level is compatible with your category.
- Select and update logging software, and test the interface with your transceiver.
- Record and test CW, RTTY, and/or SSB messages in advance.
- Ensure your signal is clean — no key clicks or SSB splatter. Ask a friend to evaluate your signal on the air if needed.
- If you’re multi-op, set up and test your logging network.
- Set your goals — personal best? Top 10? 500+ QSOs?
- Prepare snacks, meals, and drinks in advance.
- Consider your sleep schedule in advance and set an alarm clock (before the contest starts!).
- Know the log submission deadline.
- If possible, be active on the air for a few days before the contest; try to get a feel for propagation and activity.
- Check **NG3K.com** and *The Daily DX* for activity from rare multipliers (in a DX contest). Keep the list handy during the contest.

During the Contest

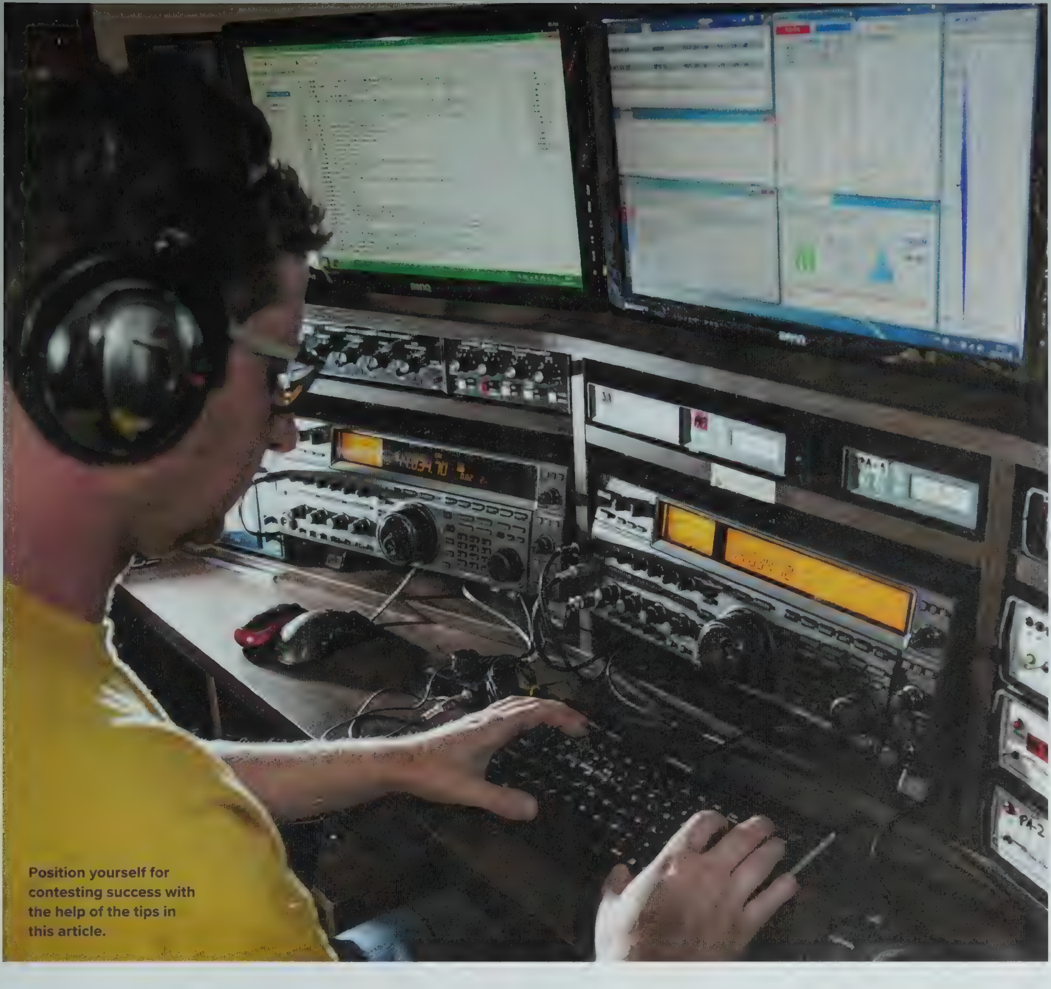
- Start on time — don’t give up operating time at the beginning!
- Send your full call when calling another station — no partials or last-two.
- Avoid time-wasting fillers, but remain approachable and friendly-sounding.
- If the rates drop, turn your keyer speed down. On phone, use your “friendly voice.”
- Don’t be a packet rat. Verify calls from the cluster and RBN.
- Use your software’s Note function to record notes about any questionable QSOs.
- Work dupes — arguing about dupes wastes time.
- If you’re operating from a DX location and you start to get a string of 6–10 dupes, you’ve been spotted incorrectly. Your best choice is often to find a new frequency (thanks W2OX/V47KP).
- Tune in the direction of the sideband — tune up the band on USB, tune down the band for LSB.

After the Contest

- Save your log to your logging computer, and back it up to a flash drive or elsewhere.
- Turn off your rig and disconnect your antennas.
- Check your Notes file and resolve any issues noted during the contest.
- Report your score to **3830scores.com**.
- Submit your Cabrillo file to the contest sponsor before the deadline.
- Let your family know that you’re alive and well!

Tips Applicable to All Contests

- Read the rules *before the contest!* Not only will it help you determine your entry category, you may find special band segments and other unusual rules that are not immediately obvious. You may even find that the rules have changed from the last time!
- If your goal is to win your category or Section/state, look over the previous year’s results.
- Establish a goal for your effort, whether it’s beating your buddy, beating your score from last year, working a few new ones, or just operating for as long as it’s fun.
- Be honest with yourself about your station’s strengths and weaknesses, and spend more time on bands and modes that play to those strengths.
- Know your radio’s functions and how to use them. There are few things more satisfying than getting the first QSO after a rare multiplier goes split



Position yourself for contesting success with the help of the tips in this article.

HENRYK KOTOWSKI, SM0JHF

because you know how to set your second VFO without fumbling.

- If your radio has a second receiver, try using the second RX to search and pounce more efficiently. Start at the bottom of the band with one RX and the top of the band with the other. It may seem awkward at first, but you'll soon be doubling your S&P rate.
- Try to think outside the box. To avoid the Sunday doldrums in Sweepstakes, K8MR operates from 3–4 different stations with different call signs. He's always "fresh meat," and often his combined scores exceed the winning single-operator score.
- Invite someone to operate your station if you can't get on, or organize a multi-op entry. Hosting and multi-ops are great opportunities to teach or learn contesting skills while enjoying the fellowship of like-minded contesters.

When Planning a Part-Time Entry

- Consider the bands, modes, and operating times that will allow for the most fun.
- Consider using packet/RBN unless you're philosophically opposed, but as the saying goes, "trust, but verify" those packet spots!

Tips for Low-Power Entries

- Choose your CQ frequency carefully. First, send "QRL?" to make sure the frequency isn't occupied. Don't open up with 100 W next to someone running high power and large antennas; you'll have a tough time getting traction.
- A few minutes calling CQ costs little and there is much to be gained. In most contests, the number of operators who are tuning the band at any given time far exceeds the number who are calling CQ. If you find a spot, jump in!

Club Contesting

Eric Silverthorn, NM5M, DFW Contest Group

Contesting as part of your club is yet one more way to have fun. Radio clubs around the country collect scores from their members and compete against other groups in the Club Competition category.

Each contest organizer has different policies on Club Competition, so be sure to familiarize yourself with the rules. For example, ARRL requires that members of a club effort reside and operate within 175 miles from the club center.

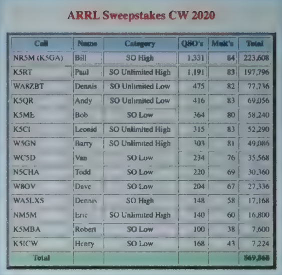
To operate as part of a club effort, you can still get on the air from your home station, as you normally would. After the contest, upload your log to **https://contest-log-submission.arrl.org/**. Be sure to include your radio club's information when you submit the log, so that your score is added to your club's overall score.

Club operating activities can be a lot of fun, especially if you compare your group's score with groups from a similar geographic area or ARRL Division. ARRL breaks out club efforts according to the size of the group, as a way of keeping operations competitive. Small clubs enter the Local category, and larger groups may qualify for the Medium or Unlimited categories.

Aside from creating a greater amount of on-air activity, club competition is a wonderful way to motivate amateurs in your area to participate in the contest and maximize their effort for the benefit of the club. Small stations as well as large stations are encouraged to participate.

The DFW Contest Group (in the North Texas Section) often organizes club efforts to maximize our score in various contests. A few weeks before a contest, emails are sent to motivate members to get on the air. We also encourage multi-operator stations to invite members who don't have a home station to join their larger effort.

One of our members, George Perkins, N5UI, has created a club score listing on our website, **www.dfwcontest.com**. Listing individual scores has created an incentive for our members to get on the air, and it gives the club leadership insight into who is getting on the air. ARRL offers awards to high-scoring clubs, so there is motivation to win!



ARRL Sweepstakes CW 2020

Call	Name	Category	QSO's	Mult's	Total
NR5M (K5GA)	Bill	SO High	1,331	84	223,608
K5RT	Paul	SO Unlimited High	1,191	83	197,796
WA8ZBT	Dennis	SO Unlimited Low	475	82	77,736
K5QR	Andy	SO Unlimited Low	416	83	69,056
K5ME	Bob	SO Low	364	80	58,240
K5CI	Leonid	SO Unlimited High	315	83	52,290
W5GN	Barry	SO Unlimited High	303	81	49,086
WC5D	Van	SO Low	234	76	35,568
N5CHA	Todd	SO Low	220	69	30,360
W8OV	Dave	SO Low	204	67	27,336
WA5LXS	Dennis	SO High	148	58	17,168
NM5M	Eric	SO Unlimited High	140	60	16,800
K5MBA	Robert	SO Low	100	38	7,600
K5ICW	Henry	SO Low	168	43	7,224
Total					869,868

DFW Contest Group lists members' scores on the group's website, to encourage members to participate in contests.

Contest Clubs

Though any club can mount a group effort in a contest, some clubs specialize in radiosport. Here are just a few.

CONTEST CLUB	WEBSITE
Alabama Contest Group	alabamacontestgroup.org
Arizona Outlaws Contest Club	www.arizonaoutlaws.net
Arizona VHF Society	www.azvhf.org
Carolina DX Association	www.cdxa.org
Central Texas DX and Contest Club	www.ctdxcc.org
Contest Club Ontario	www.va3cco.com
DFW Contest Group	www.dfwcontest.com
Florida Contest Group	floridacontestgroup.org
Frankford Radio Club	www.gofrc.org
Hudson Valley Contesters and DXers	www.qsl.net
Kentucky Contest Group	www.n4gn.com/kcg
Mad River Radio Club	www.madriverradioclub.org
Minnesota Wireless Assn	www.w0aa.org
Mt Airy VHF Radio Club	www.packratvhf.com
Niagara Frontier Radiosport	www.qrz.com/db/NF2RS
North Coast Contesters	www.northcoastcontesters.com
North East Weak Signal Group	www.newsvhf.com
Northeast Maryland Amateur Radio Contest Society	www.nemarc.org
Northern California Contest Club	www.nccc.cc
Potomac Valley Radio Club	www.pvrc.org
Rochester VHF Group	www.rvhfg.org
Society of Midwest Contesters	www.w9smc.com
South East Contest Club	southeastcontestclub.com
Southern California Contest Club	www.socalcontestclub.org
Tennessee Contest Group	k4tcg.org
Texas DX Society	www.tdxs.net
Western Washington DX Club	www.wwdxc.org
Willamette Valley DX Club	wvdxc.org
Yankee Clipper Contest Club	www.yccc.org

Contesting from the Caribbean

Antennas and palm trees — a winning combination!

RICK CREAGER, KK4GV

The Caribbean has long been a popular destination for away-from-home ham operations, and it has its pros and cons. For example, if you're there for the ARRL DX Contest, you don't need to turn your antennas — but you do end up competing with Europe and Asia at times when the stations you need to work have their antennas pointed elsewhere.

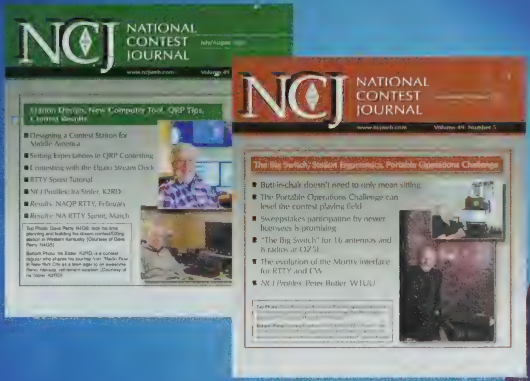
To avoid frustration and the dreaded Sunday afternoon slowdown, combine the operation with a great vacation that includes non-ham family and friends, and alter the scope — and the attitude — of the trip to maximize the fun!

Bringing a multi-operator team and their families means the more the merrier, on the air and off. There are so many things to do and see, no one will be bored. You can adjust your operating schedule to give team members as much time on the air as they want, while still being able to spend time with their families. Doug Priest, W3CF, recalled an operation in Antigua where, "two of us would be operating for a few hours, and the other two would have off. This worked out great. Each of us got a full 24 hours in the chair, but we also got to spend time with our spouses."

Some operators return to the same lodgings for years, and establish relationships with hotel and property management, which can lead to hotels or rental properties making allowances for ham operators. If you're staying in a hotel, you may be required to run tests to ensure that your radios will not interfere with the property's satellite TV services. One hotel even allowed a returning group of contesters to permanently install antennas on the property, on the condition that the antennas be made available to local amateurs should there be a communications emergency.

There are many ways to make this kind of operation easier on yourself. Many modern radios are quite small and can easily fit in your regular suitcase. Bringing radio equipment and antennas in cardboard boxes or specialized cases can draw attention to them, which you do not want. Customs agents who are not familiar with amateur radio may see your equipment as a way to collect import duty. Most airports on the islands have porters who assist vacationers with their bags and streamline their passage through customs. Use these fellows' services, and tip them well. You'll be out of the airport and on the way to your hotel in no time.

This kind of holiday-style operation can be a win-win. Everyone gets a nice vacation with beautiful views, island breezes, and great food — and the hams get to run pileups amid the camaraderie of a multi-operator effort!



NATIONAL CONTEST JOURNAL

NCJ

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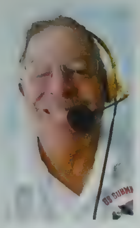
Rick Palm, K1CE, k1ce@arrl.net

Around the Horn: An Emergency Message Routing Test



Doug Stevens, WA2BBS, is an active member of the ARRL Eastern Pennsylvania (EPA) Section Amateur Radio Emergency Service® (ARES®) in Luzerne County, Pennsylvania. The late EPA Section Emergency Coordinator (SEC) Walter T. (W.T.) Jones, WN3LIF (SK), mentored Doug and a group of hams during an emergency message routing test, which Doug discusses in this month's column.

Our primary goals as ARES members are to train, practice, and prepare to be communicators during a disaster. There are many modes available for passing communications traffic, but you must always consider the worst-case scenario.

Message Routing During a Disaster

Imagine that you're at a distant incident and are given a message that must get to the county Emergency Operations Center (EOC), but all the repeaters are down and you can only hear one station. With no other outlet available, you must use that station to send the message.

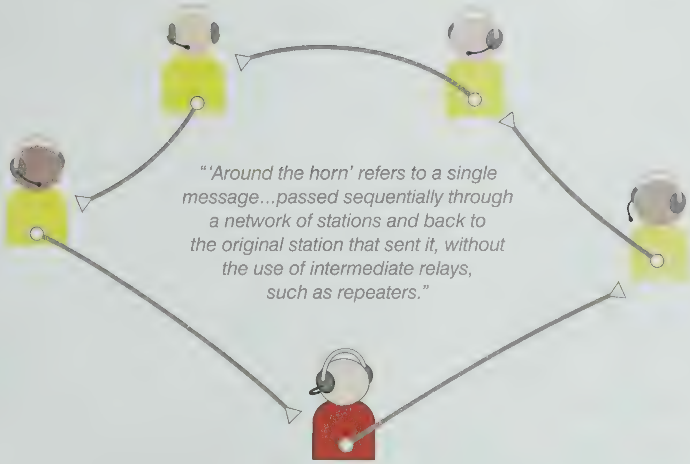
The second station can only hear you and one other station, so they send the message on to the third station, and so on, until the message reaches its destination. The message can't be sent back to a station that already handled it, because that wouldn't send it where it needs to go. The route the message takes depends on who can hear who.

The ARRL EPA Luzerne County Digital Net has been working on this problem and found that antenna issues, radio settings, terrain, and the use of digital modes can present several challenges. We're pretty good at handling messages digitally on the repeaters, but wondered what would happen if we operated using only simplex. We've done several simplex voice tests to find out if the results are the same as with a digital mode, such as *fldigi* or Winlink.

Performing the Test

Our SEC, WN3LIF (SK), came up with a test that he called "around the horn." For this test, there's no limit to the number of players, but once you're registered for the test you must participate. In baseball, "around the horn" means that if there are no runners on base and fewer than two outs after a strikeout, the ball is tossed from the catcher to third base, second base, the shortstop, first base, and then the pitcher — each player only handles the ball once.

For the purposes of ham radio, our use of "around the horn" refers to a single message getting passed sequentially through a network of stations and then back to the original station that sent it, without the use of intermediate relays, such as repeaters. The digital modes and frequencies used are up to the participants. We chose to use VHF/UHF digital simplex and the *fldigi* suite of programs for our test, but any modes can be used.



"'Around the horn' refers to a single message...passed sequentially through a network of stations and back to the original station that sent it, without the use of intermediate relays, such as repeaters."

At the beginning of your test, the message originator (who is also the final station to receive the message) will prepare a message and announce on voice that the test is starting. Next, they'll send the message to the first station designated on the list provided by the team. The message may only be sent using the chosen software (we used *flmsg*).

Each station will receive the message and send it to the next station, then save it (there's no need to "save as"). The contents of the message must not be altered, and each station can only handle it once during the test. A successful receive ("bad files" are not permitted) means that the station copied the message without checksum errors. The file name and contents must appear exactly the same as in the original message.

Once the message has been received by the next station, the sending station's participation in the test is complete; they can't receive the message again and send it to another station.

The message routing is up to the discretion of the participants. The net members must work as a team to determine how the route will work (it may help to try out your voice mode of choice prior to the test). Planning can be done any time before the "around the horn" test, and net members may communicate on voice during the test for coordination purposes. The message cannot be passed on your voice mode.

At the end of the test, all participating stations email their saved copy of the message to the originating station. For the test to be deemed a success, all stations in the net must successfully receive the message and send it to the next station, with the originating station being the last to receive it.

Participating stations must register with the originating station before the test. Stations are allowed to move to a better location, as long as they aren't more than 5 minutes away from their station's license address location.

Results

When the ARRL EPA Luzerne County Digital Net tried this test, we had one failure, but otherwise it was a success. Several issues arose prior to the test that included radio setup, antenna placement, mode used, etc. We were able to work through most of the issues.

We encourage all ARES groups and county Emergency Coordinators to try "around the horn" and share their results with each other.

I would like to thank WN3LIF (SK), for giving us this challenge and acting as mentor and referee. Other group participants were Thomas Davis, N3XMB; John DiLiberto, AB3ZI; Robert Nygren, N3RN; Robert Folmar, KB3VS; Christopher Keller, WA2EXI; Richard Tyira, KC3FKW; Timothy Chase, KC3MES, and John Denisco, K3DBG.

Feedback

In "Field Organization Reports" in the September 2021 issue, the Public Service Honor Roll contained an incorrect call sign. With a total of 580 points, ARRL recognizes Jon Wanzer, KK6GXG, for his public service performance. *QST* regrets this error.

Field Organization Reports

August 2021

Public Service Honor Roll

This listing recognizes radio amateurs whose public service performance during the month indicated 70 or more points in six categories. Details on the program can be found at **www.arrl.org/public-service-honor-roll**.

564
KB3YRU

499
W7PAT

495
WA3EZN

468
AD8CM

466
WA7PTM

448
AC0KQ

420
N9VC

350
ND8W

339
KE8BYC

315
W9GRG
W7EES

305
AL0Y

268
W9RY

265
W3GWM

260
KD2NMG

255
KD0DPX

235
KC9FXE
KT2D

220
WM5N
AB8MW

230
N5MKY

215
WA2CCN

213
KD2GXL

211
KD2LPM

205
N7CTM

200
K9LGU

198
KM8V
W0PZD

175
WO2H
KK6GXG

170
W2PH

169
N3KRX

162
K3FAZ

161
KC8T

160
N1LL
AI9F

155
N4CNX

152
N8SY

150
W8DJG
KD8ZCM
KK3F

147
WM2C
N3XMB
KC8YVF

145
WD8USA

140
WB9WKO
AD3J
K4IWW
WB9QPM

135
AC8NP
W4DNA
W3YVQ

131
KB5PGY

130
W4CMH
N2JBA
WK4WC
K8ED

129
KB1TCE
WB8YYS

125
AG9G
N2DW
KE5YTA

123
NI2W

120
WC4FSU
KA9QWC
K3JL
N2WGF
KA9MZJ
W8IM
KB8PGW
KY2D
WA4VGZ
KG5NNA
KF5OMH

115
N2LC
K1XFC

113
K8AMH

110
K6HTN
KD0HHN
WA1URS
KC8WH
W4EDN
N3SW
WA3QLW
WB8TQZ
KB2QO
KA5AZK

106
KD8KBX

105
WPAX
AD4DO
K8MDA
KD2GRS
KY2MMM

104
KV8Z

103
W3NTS

102
K9ILJ
W9EEU

100
WB4RJW
KZ8Q
KN9P
NX9K
W1KX
AC8RV
KB1NMO
K3YAK
W2AH
W3CJD
AA3SB
AK2Z
W2ZXN

99
K0FBS

97
KL7RF

96
W7PHX
KF5IVJ

95
KT5SR

92
W4TTO
K8RDN

91
W2ARP

90
KB9GO
K3MIY
KA9IKK
W1LBV
WB8SIQ
K8KRA
N8MRS
KB8HJJ
AB9ZA
N2TSO
W4KX
N4ZM
AA7BM
KJ7BHO
KA2HZP
KB3MXK

89
KI5LIC

87
AA3N
KD2PQP

86
KE4DRF
KD8UUB
KA1G
K2EAG

85
K7OED

84
KA2GQQ

83
N6IET

82
KT4WX

81
K0WAV
K6JT

80
AJ7B
KR4ST
KM4WHO
W8GSR
W9BGJ
KF7GC

79
KB2YAA

78
N0UMP
K1STM
WB8R
K2IE

77
K1HEJ

76
KF0BPN
W3ZR
WB2VUF

75
K4FHR

72
N3ARB

71
KU1U
KA2JFU

Section Traffic Manager Reports

The following Section Traffic Managers reported: AK, AR, AZ, CO, CT, DE, ENY, EPA, IL, IN, LA, LAX, MDC, ME, MI, MO, NC, ND, NFL, NLI, NM, NNJ, NTX, NV, OH, OR, SD, SFL, SJV, STX, TN, WCF, WI, WNY, WPA, WV, WWA, WY.

Section Emergency Coordinator Reports

The following Section Emergency Coordinators reported: CT, EPA, MDC, MO, ND, NLI, NM, NNY, NV, SCV, SNJ, TN, VI, WCF, WPA, WWA.

Brass Pounders League

The BPL is open to all amateurs in the US, Canada, and US possessions who report to their SMs a total of 500 or more points or a sum of 100 or more origination and delivery points for any calendar month. Messages must be handled on amateur radio frequencies within 48 hours of receipt in standard ARRL radiogram format. Call signs of qualifiers and their monthly BPL total points follow.

NX9K 1,384, KY2D 1,114, KK3F 1,014, N9CK 780, WB9WKO 737, K6HTN 563.

KY2D qualified for BPL with the following points during these previous months, but was not recognized in this column. (Jul.) 1,250. (Jun.) 2,016. (May) 1,030. (Apr.) 1,916. (Dec. 2020) 2,118.

Bruce Draper, AA5B, aa5b.corral@gmail.com

Contest Corral November 2021

Check for updates and a downloadable PDF version online at **www.arrl.org/contest-calendar**.
Refer to the contest websites for full rules, scoring information, operating periods or time limits, and log submission information.

Start - Finish								
Date-Time		Date-Time		Bands	Contest Name	Mode	Exchange	Sponsor's Website
1	0000	1	0100	1.8-28	K1USN Slow Speed Test	CW	20 WPM maximum; name, SPC	www.k1usn.com
1	0600	1	0859	3.5, 7	Silent Key Memorial Contest	CW	RST, SK call sign you want to recognize	skmc.hu/en/rules.html
1	2000	1	2130	3.5	RSGB 80-Meter Autumn Series, Data	Dig	RST, serial	www.rsgbcc.org/hf
2	0100	2	0159	1.8-50	Worldwide Sideband Activity Contest	Ph	RS, age group (OM, YL, or youth)	wwsac.com/rules.html
2	0100	2	0300	3.5-28	ARS Spartan Sprint	CW	RST, SPC, power	arsqrp.blogspot.com
2	1700	2	1900	3.5-14	RTTYops Weeksprint	Dig	Other's call, your call, serial, name	rttyops.com
3	0230	3	0300	1.8-21	Phone Weekly Test – Fray	Ph	Name, SPC	perluma.com/Phone_Fray_ Contest_Rules.pdf
3	1300	3	1400	1.8-28	CWops Mini-CWT Test	CW	Name, mbr or SPC	cwops.org/cwops-tests
3	1700	3	2000	144	VHF-UHF FT8 Activity Contest	Dig	4-char grid square	ft8activity.eu/index.php/en
3	1900	3	2000	1.8-28	CWops Mini-CWT Test	CW	Name, mbr or SPC	cwops.org/cwops-tests
3	2000	3	2100	3.5	UKEICC 80-Meter Contest	Ph	6-char grid square	ukeicc.com/80m-rules.php
4	0000	5	0300	7	Walk for the Bacon QRP Contest	CW	13 wpm max; RST, SPC, name, mbr/power	qrpcontest.com/pigwalk40
4	0300	4	0400	1.8-28	CWops Mini-CWT Test	CW	Name, mbr or SPC	cwops.org/cwops-tests
4	0700	4	0800	1.8-28	CWops Mini-CWT Test	CW	Name, mbr or SPC	cwops.org/cwops-tests
4	1700	4	1900	3.5-14	RTTYops Weeksprint	Dig	Other's call, your call, serial, name	rttyops.com
4	1800	4	2200	28	NRAU 10-Meter Activity Contest	CW Ph Dig	RS(T), 6-char grid square	nrrlcontest.no
4	1900	4	2000	3.5,7	EACW Meeting	CW	RST, mbr (if any), nickname, EA province or DXCC	eacwspain.es/eacwmeeting
4	2000	4	2200	1.8-50	SKCC Sprint Europe	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
5	0145	5	0215	1.8-21	NCCC RTTY Sprint	Dig	Serial, name, QTH	www.ncccsprint.com
5	0230	5	0300	1.8-21	NCCC Sprint	CW	Serial, name, QTH	www.ncccsprint.com
5	2000	5	2100	1.8-28	K1USN Slow Speed Test	CW	20 WPM maximum; name, SPC	www.k1usn.com
6	0500	6	1200	3.5-28	IPARC Contest, CW	CW	RST, serial, IPA, US state (if USA)	www.iparc.de
6	1200	7	1200	1.8-28	Ukrainian DX Contest	CW Ph	RS(T), 2-letter Ukraine oblast or serial	urdxc.org/rules.php?english
6	1300	6	1330	144	Two-Meter Classic Sprint	CW Ph	serial + 4-char grid square	fwrc.info
6	2100	8	0259	1.8-28	ARRL Sweepstakes Contest, CW	CW	Serial, precedence, your call, check, ARRL/RAC Section	www.arrl.org/sweepstakes
7	0500	7	1200	3.5-28	IPARC Contest, SSB	Ph	RST, serial, IPA, US state (if USA)	www.iparc.de
7	0800	7	1200	Any	EANET Sprint	CW Ph Dig	RS(T)	fediea.org/news/?news=20201108
7	1400	7	1700	3.5-28	High Speed Club CW Contest	CW	RST, mbr or "NM"	www.highspeedclub.org
10	1700	10	2000	432	VHF-UHF FT8 Activity Contest	Dig	4-char grid square	ft8activity.eu/index.php/en
10	2000	10	2130	3.5	RSGB 80-Meter Autumn Series, SSB	Ph	RS, serial	www.rsgbcc.org/hf
13	0000	14	2359	3.5-28	WAE DX Contest, RTTY	Dig	RS, serial	darc.de/der-club/referate/conteste
13	0000	14	2359	3.5-144	Day of the YLs Contest	CW Ph	RS(T), YL/OM	ka1uln.blogspot.com
13	0000	15	2359	1.8-7	PODXS 070 Club Triple Play Low Band	Dig	RST, SPC	www.podxs070.com
13	0001	14	2359	28	10-10 International Fall Contest, Digital	Dig	Name, mbr or "0," SPC	www.ten-ten.org/
13	0500	14	1100	50-1296	SARL VHF/UHF Analogue Contest	CW Ph	RS(T), 6-char grid locator	www.sarl.org.za
13	0700	14	1300	1.8-28	JIDX Phone Contest	Ph	RST, JA prefecture number or CQ zone	jidx.org/jidxrule-e.html
13	1200	14	1200	1.8-28	OK/OM DX Contest, CW	CW	RST, 3-letter OK/OM district code or serial	okomdx.crk.cz/index. php?page=english
13	1200	14	2359	1.8-50	SKCC Weekend Sprintathon	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
13	1600	13	1800	3.5-28	FISTS Saturday Sprint	CW	RST, SPC, name, mbr or "0"	fistsna.org/operating.html#sprints
13	1900	15	0500	1.8-432	CQ-WE Contest	CW Ph Dig	Name, location code, years of service	cqwe.cboh.org/rules.html
13	2300	22	0300	1.8-14	AWA Bruce Kelley 1929 QSO Party	CW	RST , name, QTH, equipment year/type/power	antiquewireless.org/homepage
14	0700	14	1700	3.5-28	FIRAC HF Contest	Ph	RS(T), serial	www.firac.de
14	1400	17	0800	1.8-144	Classic Exchange, Phone	Ph	Name, RS, SPC, rig manuf/model	www.classicexchange.org
15	0100	15	0300	1.8-28	4 States QRP Second Sunday Sprint	CW Ph	RS(T), SPC, mbr or power	www.4sqrp.com
18	0000	19	0300	14	Walk for the Bacon QRP Contest	CW	13 wpm max; RST, SPC, name, mbr/power	qrpcontest.com/pigwalk20
18	0130	18	0330	3.5-14	NAQCC CW Sprint	CW	RST, SPC, mbr or power	naqcc.info
19	1600	19	2200	3.5	YO International PSK31 Contest	Dig	RST, serial, country or YO county	www.yo5crq.ro/Rules.htm
20	0000	21	2359	50-1296	ARRL EME Contest	CW Ph Dig	Signal report	www.arrl.org/eme-contest
20	1200	21	1200	3.5-28	LZ DX Contest	CW Ph	RS(T), 2-letter LZ district or ITU zone	lzdx.bfra.org/rulesen.html
20	1600	20	2359	1.8	All Austrian 160-Meter Contest	CW	RST, serial, district code (if OE)	www.oevsv.at
20	1700	21	0100	1.8	REF 160-Meter Contest	CW	RST, serial, department code	concours.r-e-f.org/reglements/index.php
20	1900	20	2059	1.8-50	Feld Hell Sprint	Dig	RST, mbr, SPC, grid	sites.google.com/site/feldhellclub
20	1900	20	2300	1.8	RSGB 1.8-MHz Contest	CW	RST, serial, district code (if UK)	www.rsgbcc.org/hf
20	2100	22	0259	1.8-28	ARRL Sweepstakes Contest, SSB	Ph	Serial, precedence, your call, check, ARRL/RAC Section	www.arrl.org/sweepstakes
21	1300	21	1700	3.5, 7	Homebrew and Oldtime Equipment Party	CW	RST, serial, class	qrpcc.de/contestrules/hotr.html
21	2100	21	2300	3.5-28	FISTS Sunday Sprint	CW	RST, serial, SPC, name, mbr or "0"	fistsna.org
21	2300	22	0100	1.8-28	Run for the Bacon QRP Contest	CW	RST, SPC, mbr or power	qrpcontest.com/pigrun
24	0000	24	0200	1.8-50	SKCC Sprint	CW	RST, SPC, name, mbr or "none"	www.skccgroup.com
24	2000	24	2100	3.5	UKEICC 80-Meter Contest	CW	6-char grid square	ukeicc.com/80m-rules.php
25	2000	25	2130	3.5	RSGB 80-Meter Autumn Series, CW	CW	RST, serial	www.rsgbcc.org/hf
27	0000	28	2359	1.8-28	CQ Worldwide DX Contest, CW	CW	RST, CQ zone	www.cqww.com/rules.htm
29	2000	29	2130	3.5-14	RSGB FT4 Contest Series	Dig	4-char grid square	www.rsgbcc.org/hf

There are a number of weekly contests not included in the table above. For more info, visit: **www.qrpfoxhunt.org**, **www.ncccsprint.com**, and **www.cwops.org**. All dates refer to UTC and may be different from calendar dates in North America. Contests are not conducted on the 60-, 30-, 17-, or 12-meter bands. Mbr = Membership number. Serial = Sequential number of the contact. SPC = State, Province, DXCC Entity. XE = Mexican state. Listings in blue indicate contests sponsored by ARRL or *NCJ*. The latest time to make a valid contest QSO is the minute listed in the "Finish Time" column. *Data for Contest Corral is maintained on the WA7BNM Contest Calendar at* **www.contestcalendar.com** *and is extracted for publication in* QST *2 months prior to the month of the contest. ARRL gratefully acknowledges the support of Bruce Horn, WA7BNM, in providing this service.*

Frequency Measuring Test — November 2021

Due to a high solar flux, two stations will cover North America.

Ward Silver, NØAX
n0ax@arrl.org

Solar Cycle 25 is causing an increased number of sunspots, but a higher solar flux makes propagation a little more difficult on the lower bands. Because of this, the Frequency Measuring Test (FMT) will use a dual-station format this November. This should give stations throughout North America an opportunity to receive and measure a strong signal.

If you've never entered an FMT before, information on how to measure the frequency of a carrier is available at **www.k5cm.com**.

Measurement Software

The free software tools available are quite advanced. If you're already using the *WSJT-X* suite on FT8 or WSPR, you can use its frequency calibration mode as a sophisticated frequency measuring tool. George Allison, K1IG, discusses how to use *Spectrum Lab*, *fldigi*, and WSPR for FMT measurements at **www.ve2azx.net/technical/FreqCal.pdf**.

Additionally, Joe Taylor, K1JT, explains how to use *WSJT-X* for frequency measurement in *Accurate Frequency Measurements with your WSPR Setup* (**physics.princeton.edu/pulsar/k1jt/FMT_User.pdf**).

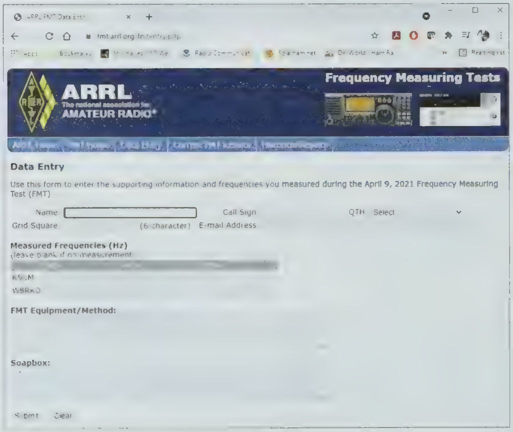
FMT Schedule and Format

The FMT "runs" will start with a call up at 0230 UTC on November 12 (Thursday evening in North America). FMT Manager Connie Marshall, K5CM, notes that the call up may start earlier than the listed times to establish a clear frequency, if necessary, but every effort will be made to start the key down transmissions at the published time in Table 1. A single, unmodulated carrier will be transmitted near those FMT frequencies.

K5CM will transmit from Oklahoma, and Michael Suhar, W8RKO, will transmit from Ohio. Be prepared to tune to find the call up transmissions, if necessary.

Similar to last year, there will be a slight shift in the frequency to be measured. You'll hear the frequency shift shortly after the call up. The test transmission will be near (but not exactly on) the call up frequency. One measurement for 40 meters and one reading for 80 meters should be submitted.

Submit your measurements using the data entry website at **fmt.arrl.org/fmtentry.php**. Results will be published immediately following the data entry deadline, 0200 UTC on November 15 (Sunday evening, November 14, in North America).



Data Entry

Use this form to enter the supporting information and frequencies you measured during the April 9, 2021 Frequency Measuring Test (FMT)

Name ☐ Call Sign QTH Select
Grid Square (6 character) E-mail Address

Measured Frequencies (Hz)
(leave blank if no measurement

K5CM
W8RKO

FMT Equipment/Method:

Soapbox:

Submit Clear

The online data entry form is available at **fmt.arrl.org/fmtentry.php**. Please include notes and observations about making your measurement, including the equipment used and any special techniques. Results are published immediately following the submission deadline.

Table 1
Frequency Measuring Test Schedule

Start: November 12 at 02:30 UTC
(Thursday evening in North America)

Results: Submit measurements online
until November 15 at 02:30 UTC
(Sunday evening in North America)

40 Meters: K5CM near 7064 kHz
02:30 Call up
02:33 Key down
02:34 End 40-meter run

40 Meters: W8RKO near 7064 kHz
02:45 Call up
02:48 Key down
02:49 End 40-meter run

80 Meters: K5CM near 3598 kHz
03:00 Call up
03:03 Key down
03:04 End 80-meter run

80 Meters: W8RKO near 3598 kHz
03:15 Call up
03:18 Key down
03:19 End 80-meter run

If there's interference on the published frequency, tune around to find the FMT transmissions.

The 2021 ARRL 160-Meter Contest

2200 UTC Friday, December 3 – 1559 UTC Sunday, December 5

ARRL's 160-Meter Contest gives participants an opportunity to log another state for the Worked All States Award (WAS) or a new country for DXCC. Even if you don't have a dedicated 160-meter antenna, you can load up any length of wire to make contacts. Give it a try and you might be surprised by the results!

- Operate using CW only (1.830 – 1.835 MHz should be used for intercontinental contacts only).
- Categories include Single Operator or Single Operator, Unlimited (spotting assistance allowed), at the high, low, or QRP power levels. There's also the option of operating Multioperator, Single Transmitter (use of spotting networks is permitted) at high or low power.
- DX stations work stations in ARRL/RAC Sections. W/VE stations work stations in ARRL/RAC Sections and DXCC entities.
- KL7, KH0 – KH9 (including KH6), and KP1 – 5 stations count as US sections and may be contacted by DX, US, and VE stations.

7-Day Log Deadline: ARRL 160-Meter Contest logs must be uploaded via our web app (**http://contest-log-submission.arrl.org**) or postmarked by 1559 UTC December 12, 2021. Paper logs can be sent to ARRL 160-Meter Contest, 225 Main St., Newington, CT 06111.

During the 2020 ARRL 160-Meter Contest, Bryan "Tom" Bydal, W5MX, was excited about his top-ten finish in the Single Operator, High Power category. [Bryan "Tom" Bydal, W5MX, photo]

Special Event: 160-Meter Transatlantic Centenary QSO Party

0200 – 0800 UTC Sunday, December 12, 2021

ARRL and the Radio Society of Great Britain (RSGB) will each activate special event stations for 6 hours on 160 meters to commemorate the 100th anniversary of the Transatlantic Tests. In 1921, ARRL sent Paul F. Godley, 2ZE, to Ardrossan, Scotland for the first successful listening test. Godley received the signals of more than 2 dozen American stations, heralding the dawn of Amateur Radio Transatlantic communications. To celebrate the historic achievement, ARRL will activate W1AW, and RSGB will activate GB2ZE from Scotland. The stations will operate on CW only. If propagation across the Atlantic holds up, the stations may continue to operate beyond 0800 UTC. GMDX Group of Scotland will award a *quaich* (a traditional Scottish drinking cup representing friendship) to the first stations in North America and the UK to complete contacts with both W1AW and GB2ZE during the QSO party. The results will be published jointly by ARRL and RSGB, and there will be a commemorative certificate for stations that work one or both of the activations. For more information, visit **arrl.org/transatlantic** and **rsgb.org/transatlantic-tests**.

Complete rules, multiplier lists, and forms can be found at **www.arrl.org/160-meter**

The 2021 ARRL 10-Meter Contest

0000 UTC Saturday, December 11 – 2359 UTC Sunday, December 12

Regardless of your experience level, the 2021 ARRL 10-Meter Contest offers something for everyone — beginners and more experienced operators can all join the fun!

This contest relies in part on winter E-skip, so propagation may favor higher activity during daylight hours. Be on the lookout for some unexpected band openings and favorable propagation. Solar Cycle 25 may offer up surprises on 10 meters.

There are categories for Single Operator and Multioperator entrants. Stations can be contacted on CW, phone, or both.

Multipliers include US and Mexican states, Canadian provinces, and DXCC countries (excluding the US, Mexico, and Canada). Complete rules, multiplier lists, and forms can be found at **www.arrl.org/10-meter**.

7-Day Log Deadline: ARRL 10-Meter Contest logs must be uploaded via our web app (**http://contest-log-submission.arrl.org**) or postmarked by 2359 UTC December 19, 2021. Paper logs can be sent to ARRL 10-Meter Contest, 225 Main St., Newington, CT 06111.

The December 2021 ARRL Rookie Roundup — CW

1800 UTC – 2359 UTC, Sunday, December 19

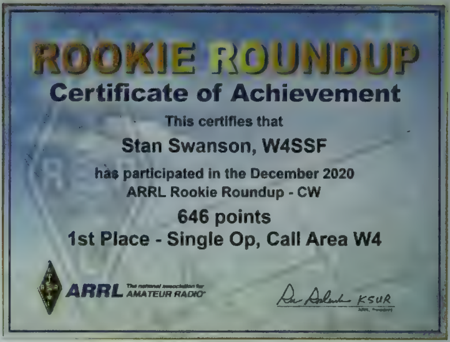
The Rookie Roundup is an event to encourage newly licensed operators to get on the HF bands and experience competitive amateur radio operating. This is a great way for clubs to get newer members on the air and the perfect opportunity to be a mentor to new licensees.

Rookies will attempt to make as many contacts as possible during this 6-hour event. Rookies work everyone, and non-Rookies work only Rookies. Stations exchange each other's call signs, first names, a two-digit year, and state (US or Mexican), Canadian province, or "DX."

You can enter as a Rookie if:

- You made or will make your first-ever contact this year or during the previous 3 calendar years (send the last two digits of the year of your first contact in your exchange),
- Or you've never made any contest contacts using CW (send the last two digits of the current year in your exchange).

If you're a non-Rookie, send the last two digits of the year of your first license.



ROOKIE ROUNDUP
Certificate of Achievement
This certifies that
Stan Swanson, W4SSF
has participated in the December 2020
ARRL Rookie Roundup - CW
646 points
1st Place - Single Op, Call Area W4
ARRL The national association for AMATEUR RADIO
K5UR

Rookie Roundup participants can download a certificate (available at **contests.arrl.org/certificates.php**) suitable for framing to display their achievement. Stan Swanson, W4SSF, earned first place in the Single Operator category in the W4 call area during the December 2020 ARRL Rookie Roundup CW event.

Rookies can enter as a Single Operator or invite Rookie friends over and operate as Multioperator. Up to five Single Operator Rookies can also enter from their individual stations and submit their total score as a team!

Non-Rookies can join in the fun by calling "CQ Rookies," encouraging the Rookie operators to call you.

All scores must be reported within 72 hours after the event. No late entries will be accepted.

Complete rules, log sheets, and links for submitting your score can be found at **www.arrl.org/rookie-roundup**

Melissa Stemmer, KA7CLO, mstemmer@arrl.org

At the Foundation

The ARRL Foundation Board of Directors is pleased to announce four new scholarships established to assist amateur radio operators with college or university costs.

The CWops Scholarship

The CW Operators' Club (CWops) has endowed a $1,000 scholarship for students who demonstrate CW operating ability within the last 24 months by providing a copy of a certificate, a listing in a magazine showing results, or a letter from a person responsible for membership. There are no requirements as to field of study, location, or nationality.

The Ronald Hesselbrock, WA8LOW, Memorial Scholarship

The estate of Ronald Hesselbrock, WA8LOW, has endowed a $10,000 scholarship for students who have held their amateur radio license and who have been a member of ARRL for a minimum of 1 year prior to the application date. Applicants must demonstrate they are active in amateur radio by submitting a letter from an amateur radio club officer or from an official in ARRL Field Services verifying their activity.

The Robert A. Rodriguez, K5AUW, Scholarships

Funded by the San Antonio Radio Club, two $1,000 scholarships will be awarded to students pursuing studies in electrical engineering, electronics engineering, computer engineering, electrical technology, electronics technology, or computer technology. Preference will be given to applicants who reside in the ARRL South Texas Section (first preference), the State of Texas (second preference), or the ARRL West Gulf Division (third preference).

The John C. York, KE5V, Scholarship

Funded through a donation by Bernie Krasowski, KD5QHV, in honor of John C. York, KE5V, this $1,000 scholarship is for students pursuing a field of study leading to a career in the healing arts, including but not limited to a career in medicine, nursing, dentistry, pharmacy, EMT, or radiology. Applicants should describe how they have engaged in volunteer and/or public service activities making use of amateur radio.

How to Apply

Full scholarship eligibility requirements for all scholarships can be found at **www.arrl.org/scholarship-descriptions**. The 2022 Scholarship Program will be accepting applications online from November 1, 2021 until December 31, 2021. For the first time, transcripts and any additional required documents must be submitted with the application. If you are a high school senior or attending college next year and you are an FCC-licensed, active amateur radio operator, you are encouraged to apply. Awards will be announced in May 2022. Awards are sent directly to recipients' colleges.

To learn more about the ARRL Foundation Scholarship Program, please visit **www.arrl.org/scholarship-program**.

Maty Weinberg, KB1EIB, events@arrl.org; www.arrl.org/special-event-stations

Special Event Stations

Working special event stations is an enjoyable way to help commemorate history. Many provide a special QSL card or certificate!

Through – Nov. 30, 0000Z – 2300Z, II3VE, Venezia, Italy. ARI Venezia. **1,600 Years of the Foundation of Venice**. All bands. Certificate & QSL. Sezione ARI Venezia, S. Croce 1776/B, Venezia 30135, Italy. *Detailed rules on ARI Venezia website and on* **QRZ.com** *for II3VE. Both II3VE and club call IQ3VE are valid. QSL via eQSL or bureau.* **www.arivenezia.it**

Through Dec. 31, 0000Z – 2359Z, all calls, all areas. VE2GT and VE2NCG. **Quebec Parks on the Air (QCPOTA)**. Certificate. *This is an operating event; see website for details.* **qcpota.ca**

Oct. 22 – Oct. 24, 1400Z – 2359Z, N4H, Tarpon Springs, FL. Upper Pinellas Amateur Radio Club. **100th Anniversary of the 1921 Hurricane**. 14.265 14.074 7.265 7.074. Certificate & QSL. UPARC QSL, P.O. Box 1684, Tarpon Springs, FL 34688. **www.w8rd.net/hurricane**

Oct. 22 – Oct. 25, 2000Z – 2000Z, K5D, Gautier, MS. The Jackson County Amateur Radio Association, Inc. **Deer Island MS 0115 Expedition, US Islands Awards Program**. 21.350 14.250 7.250. QSL. The Jackson County Amateur Radio Association, P.O. Box 234, Gautier, MS 39553.

Oct. 31 – Nov. 1, 0001Z – 0400Z, KC5BOO, Cleburne, TX. Club KC5NX. **Boo to You!** 14.310. QSL. Judy Cox, 3701 Park Rd. 21, Cleburne, TX 76033. **kc5boo@yahoo.com**

Oct. 31 – Nov. 1, 0300Z – 0400Z, WA4TRS, Bat Cave, NC. The Road Show Amateur Radio Club, Inc. **A Night on Bald Mountain**. 14.331 7.331. Certificate & QSL. The Road Show Amateur Radio Club, Inc., 57 Echo Lake Dr., Fairview, NC 28730. **www.roadshowarc.org**

Nov. 1 – Nov. 15, 0000Z – 0000Z, N5VET, Cleburne, TX. Club KC5NX. **Veterans Day 2021**. 14.255 14.045 7.240 7.235. QSL. Club KC5NX, 9200 Summit Ct. W., Cleburne, TX 76033. **www.qrz.com/db/kc5nx**, **jay.n.violet@gmail.com** *or* **www.qrz.com/db/n5vet**

Nov. 5 – Nov. 6, 2300Z – 2200Z, W9TAL, Ottawa, IL. The American Legion Post 33 Amateur Radio Club. **13th Annual Veteran Honor Guard Vigil at the Ottawa Illinois War Memorial**. 7.200 3.900. QSL. Joe Tokarz, TALARC Post 33, 901 La Salle St., Ottawa, IL 61350-4223. **www.ottawaalpost33.com**

Nov. 6, 1400Z – 2200Z, K5U, McKinney, TX. McKinney Amateur Radio Club. **Veterans Day Salute to the USO**. 14.322. QSL. Dave Marking, 6710 Virginia Pkwy., Ste. 215, PMB 52, McKinney, TX 75071. **www.qrz.com/db/k5u**

Nov. 7, 1400Z – 2000Z, W4CA, Roanoke, VA. Roanoke Valley Amateur Radio Club. **Mill Mountain Star**. 14.265 7.265. QSL. Roanoke Valley ARC, P.O. Box 2002, Roanoke, VA 24009. **www.w4ca.com/special-events**

Nov. 9 – Nov. 10, 1700Z – 0100, N9H, Rochester, NY. W2JLD. **Hedy Lamarr Day 2021**. ROC-HAM/EchoLink 531091; AllStar 2585,47620,47918; other EchoLink conferences will be connected for this. QSL. John Derycke, W2JLD, 85 Amherst St., Apt. 2, Rochester, NY 14607. **www.roc-ham.net**

Nov. 12 – Nov. 13, 1400Z – 2100Z, NB9QV, Manitowoc, WI. USS *Cobia* Amateur Radio Club. **Celebrating Veterans Day**. 14.240 7.240. QSL. Fred Neuenfeldt, W6BSF, 4932 S. 10th St., Manitowoc, WI 54220. **www.qrz.com/db/nb9qv**

Nov. 13, 1500Z – 2100Z, WX4SC, Gaffney, SC. Carolina Amateur Radio Emergency Services. **Cherokee County Veteran's Appreciation Day**. 7.225 145.150 (no tone). Certificate. CARES, P.O. Box 8006, Gaffney, SC 29340. **ki4mjk@gmail.com** *or* **www.facebook.com/Carolina-Amateur-Radio-Emergency-Services-230499684304071**

Nov. 13, 1700Z – 2359Z, NI6IW, San Diego, CA. USS *Midway* (CV-41) Museum Ship. **Celebrating Veterans Day and US Marine Corps Birthday**. 14.320 7.250 PSK and CW on various HF bands; D-STAR on various reflectors. QSL. USS *Midway* Museum Ship COMEDTRA, 901 N. Harbor Dr., San Diego, CA 92101. *Check spotting networks to find us on HF,* **www.dstarusers.org** *to find NI6IW, and Reporting Note to see what reflector we're using.* **www.qrz.com/db/ni6iw**

Nov. 13 – Nov. 14, 1700Z – 0000Z, W6TOI, Downey, CA. Downey Amateur Radio Club, Inc. **70th Anniversary**. 28.425 21.325 14.270 7.225. Certificate. Downey Amateur Radio Club, P.O. Box 207, Downey, CA 90241. **https://darcarc.wordpress.com**

Nov. 17, 1500Z – 2400Z, K7GST, Prescott, AZ. Yavapai Amateur Radio Club. **NRA's 150th Birthday Party**. 21.3325 14.250 14.040 7.250. Certificate. eCertificate (preferred) or direct to: YARC, P.O. Box 11994, Prescott, AZ 86304. **www.w7yrc.org/nrabirthday**

Nov. 17 – Nov. 19, 0800Z – 2000Z, W4H, Mars Hill, NC. High Appalachian Mountain Amateur Radio Society**. 2021 Hammarlund Radio Hullabaloo**. 14.250 14.071 14.045 7.250. QSL. Jerry Robinson, P.O. Box 366, Mars Hill, NC 28754. **www.hamars.club**

Nov. 20, 1400Z – 2000Z, W1M, Russell, MA. Western Mass Council BSA. **WHOA Weekend**. 7.060 7.250 14.060 14.250. QSL. Tom Barker, 329 Faraway Rd., Whitefield, NH 03598. *Paper logging, eQSL, and USPS for QSL card.*

Certificates and QSL cards: To obtain a certificate from any of the special event stations offering them, send your QSO information along with a 9 × 12 inch self-addressed, stamped envelope (three units of postage) to the address listed in the announcement. To receive a special event QSL card (when offered), be sure to include a self-addressed, stamped business envelope along with your QSL card and QSO information.

Special Events Announcements: For items to be listed in this column, use the ARRL Special Events Listing Form at **www.arrl.org/special-events-application**.

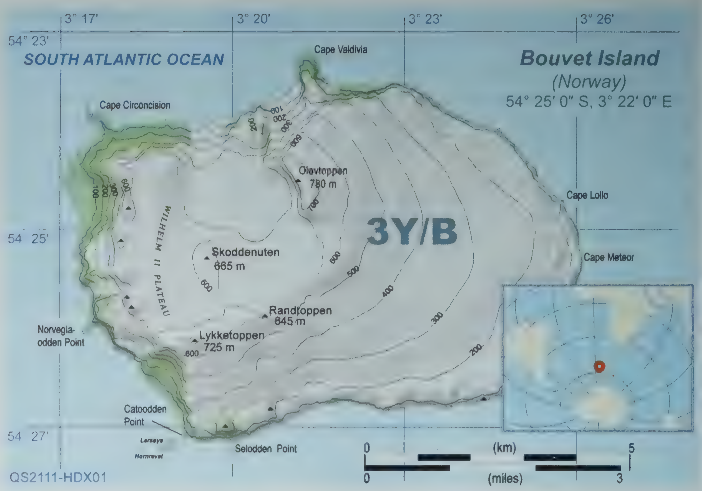
Submissions must be received by ARRL HQ no later than the 1st of the second month preceding the publication date; a special event listing for **February** *QST* would have to be received by **December 1**. In addition to being listed in *QST*, your event will be listed on the ARRL Web Special Events page. Note: All received events are acknowledged. If you do not receive an acknowledgment within a few days, please contact us. ARRL reserves the right to exclude events of a commercial or political nature.

You can view all received Special Events at **www.arrl.org/special-event-stations**.

Bernie McClenny, W3UR, w3ur@arrl.org

How's DX?

The Unique History of Bouvet Island



The second-most-wanted DXCC entity, Bouvet Island, is located 2,563 kilometers south of Cape Town, South Africa.

Bouvet Island (Bouvetøya to Norwegians) is a subantarctic volcanic island located in the South Atlantic Ocean, some 2,563 kilometers (1,593 miles) from Cape Town, South Africa, and can be found at 54° 25′ South and 3° 22′ East. The island is almost entirely covered by glaciers, and because it's not located below the 60th parallel south, it's not part of the 1961 Antarctic Treaty System. This treaty relates to all land and ice shelves below 60 degrees south of the Earth's equatorial plane. There can't be any new DXCC countries in this region because those who've signed the treaty agreed not to dispute or establish territorial claims, or assert new ones.

The island was discovered on January 1, 1739, by Jean-Baptiste Charles Bouvet de Lozier, a French naval officer. Captain Harald Horntvedt landed on the island on December 1, 1927, and claimed it for Norway. It was then annexed on January 23, 1928, and became a dependent territory of Norway on February 27, 1930.

DXCC History

Bouvet Island (3Y/B) wasn't on the original post-World War II DXCC list, which was published in 1947. The March 1963 issue of *QST* announced the addition of the island to the ARRL DXCC list (at this time, there weren't set criteria for adding and deleting countries). Under today's criteria, it would meet the rules for a geographically separate entity, as it's well over 350 kilometers from Norway.

At the time of the *QST* announcement, contacts with the world's most remote island could be credited starting May 1, 1963 for contacts made on or after November 15, 1945, which was the start date of the current DXCC program. For the Worked All Continents Award (WAC), it counts for Africa and is located in CQ Zone 38. Bouvet Island counts as AN-002 for Islands On The Air (IOTA).

There have only been nine activations from this rare location, all of which count for DXCC. The first operation that counted for Bouvet Island was LH4C by Gus Browning in November 1962. Fifteen years later was the first Norwegian operation, which lasted only 2 hours. It occurred on February 24, 1977 at Cape Fie, and was done by Audun Hjelle, LA3CC, operating as 3Y3CC (who made 28 contacts), and John Snuggerud, LA1VC, as 3Y1VC (who made 27 contacts). From December 1978 to January 1979, Thore Winsnes, LA5DQ (SK), was there working and operating as 3Y5DQ in his spare time, with 550 contacts in the log. Also during that time, LA1VC went back to Bouvet to operate as 3Y1VC. During the first 3 months of 1979, he made 1,930 contacts.

The first multioperator DXpedition to Bouvet was 3Y5X, from December 28, 1989 to January 13, 1990. The team included Einar Enderud, LA1EE; Kåre Pedersen, LA2GV; Jin Fujiwara, JF1IST; Jacky Clavo, F2CW (now ZL3CW), and Willy Rüsch, HB9AHL. They made 47,010 contacts. The team arrived via a small boat, while their equipment was flown by helicopter from the ship to the island. You can watch a 30-minute video of this operation at **www.youtube.com/watch?v=fPz_c5BcTUU&t=1745s**.

On February 22, 1997, Kåre Pedersen, LA2GV, who was part of the 1996/97 Norwegian Antarctic Research Expedition, was able to go ashore and operate as 3Y2GV, making about 200 contacts in 2 – 3 hours. Astronaut and doctor Chuck Brady, N4BQW (SK), was there

3 Y0C
Bouvet Island
IOTA: AN-002

Chuck Brady, N4BQW (SK), was an astronaut, doctor, and amateur radio operator. In late 2000 and early 2001, Brady was part of the Norwegian Antarctic Research Expedition and operated in his spare time, making around 8,000 contacts as 3Y0C.

accompanying the Norwegian Antarctic Research Expedition for several months in late 2000 and early 2001. He made around 8,000 contacts as 3Y0C. The last operation from 3Y/B was between December 2007 and February 2008. Petrus Kritzinger, ZS6GCM (also ZS8T), was working on the island and active in his spare time as 3Y0E.

Afterward, the licenses 3Y0G and 3Y0H were issued to Mark Demeuleneere, ON4WW, and Dmitry Zhikharev, RA9USU, respectively, but both of them decided not to go.

Since then, there have been two attempts, both of which failed. The first was the 3Y0Z team in 2018. They got within sight of the island and had to abort due to serious engine troubles aboard the MV *Betanzos*. The second was in March 2019 by the Rebel DX Group, led by Dom Grzyb, 3Z9DX, but they were overtaken by a serious storm within several hundred miles of the island.

A Change of Plans

In April 2021, the Intrepid-DX Group, led by Paul Ewing, N6PSE, teamed up with Ken Opskar, LA7GIA, announcing their 2023 Bouvet Island DXpedition (see the June 2021 "How's DX?" column for more information). Originally, they were going to travel via the MV *Braveheart*, but the ship was sold. The team refunded all of the donations and began looking at other transportation options. However, they decided to part ways.

In the beginning of August, the Intrepid-DX Group decided not to go to Bouvet Island and are now planning on activating "a different rare and much-needed entity in January/February 2023."

Looking Ahead

Currently, there are two groups heading to 3Y/B, which happens to be the second-most-wanted DXCC entity on Club Log's Most Wanted DXCC List.

Dom Grzyb, 3Z9DX, and his team are expected to depart for 3Y/B around mid-December 2021. Updates can be found on their website at **https://bouvetoya.org**, or at your favorite DX outlet.

The second group will be led by Ken Opskar, LA7GIA; Rune Øye, LA7THA, and Erwann Merrien, LB1QI. Joining them will be Gjermund Bringsvor, LB5GI; Adrian Ciuperca, KO8SCA; Laci Radócz, HA0NAR; Dmitry Zhikharev, RA9USU; Bill Straw, KO7SS; Sandro Nitoi, VE7NY; Axel Schernikau, DL6KVA; Dr. Mike Crownover, AB5EB, and one more team member who hasn't been announced. They're aiming to have 3Y0J on the air in November of next year. More details and photos can be found on their website at **www.3y0j.no**.

This team is planning to operate from Cape Fie on the southeastern side of the island. Reportedly, this is the only place to safely stay overnight. They won't be permitted to set up on the beach, so they'll have to set up camp on the rocks above the beach, which is some 80 meters (250 feet) above the landing site. The team will set up a winch system to lift their equipment from the beach to the overlook. They're anticipating spending 2 days to get the camp set up.

They plan to be operational on 160 through 10 meters, including 60 meters and the WARC bands, on SSB, CW, FT4, FT8, and RTTY.

Sponsorship

The 3Y0J team said, "With an overall budget of $650,000, this will be the most expensive DXpedition ever." Support is being sought from corporations, clubs, foundations, and individuals. On August 30, the Northern California DX Foundation (NCDXF) announced they're "granting $100,000 to the 3Y0J 2022 Bouvet Island DXpedition planned for November 2022." This is the biggest grant NCDXF has ever given for a DXpedition. By the end of October, the team needs to have 30% down on the vessel in order to ensure a November 2022 DXpedition. The goal for the 3Y0J DXpedition to Bouvet Island is to make 120,000 contacts. Visit their planning site at **www.3y0j.no**.

Wrap-Up

That's it for this month. Don't forget to send your DX news, whether it's a serious or "holiday" operation, to **bernie@dailydx.com**. Until next month, see you in the pileups!
— Bernie, W3UR

Jon Jones, N0JK, n0jk@arrl.org

Solar Cycle 25 Brings November F2

F2 propagation on 50 MHz may appear for the northern hemisphere in November 2021 as the pace of Solar Cycle 25 picks up. Solar Cycle 25 is running ahead of schedule, with the peak possibly occurring in fall 2024, which is a year earlier than previously predicted. The effect of the winter anomaly begins in November, which creates higher F-layer MUF (maximum usable frequency).

The most likely scenario for a 6-meter F2 opening in fall 2021 is during, or just after, a geomagnetic storm. The high geomagnetic activity can boost the MUF on north-south paths, such as North America to the Caribbean and South America or North America to Oceania. It takes a much higher sustained solar flux for the transatlantic path to open. Watch websites such as **Solarham.com** and **Spaceweather.com** for updates.

2021 Perseid Meteor Shower

KB7Q (DN54) 222 MHz, Wyoming

Gene Shea, KB7Q, operated from the Beartooth Plateau (DN54fw) on 222 MHz in August (see Figures 1 and 2). He worked eight stations on MSK144 meteor scatter, including W5ZN at 1,150 miles for his state #45. On moonbounce, he logged four stations, including WA4NJP for his state #48. Dave, N9HF (EL99) also worked KB7Q/p on EME using JT65B for his state #42 on 222 MHz.

N7GP/R (DN76, DN77, DN85, and DN86), South Dakota

Also in August, Tom, N7GP/R (ex-WA8WZG), was active on 6 meters. He made 237 contacts, most on MSK144 and a few on FT8. I (N0JK, EM28) logged Tom in DN77 and DN85 on MSK144. AA0MZ (EM29) worked him in DN85 for one of his last Fred Fish Memorial Award (FFMA) grids.

N0LL/P (EM07), Kansas

Larry, N0LL, operated again from EM07, focusing on 6 meters. He made 94 good MSK144 contacts, 111 FT8 contacts, and 30 incomplete contacts. He was on the air by 5 AM each day until around 1:30 PM in the afternoon. He tried to work Hal, N7NW (CN87), who only needs a couple of grids to complete the FFMA, with EM07 being one of them, but there was only one decode from Hal. Overall, Larry said the Perseid meteors "were excellent." (see Figure 3). He noted that he "had some intermittent E_S for FT8 during the late morning." He made one MSK144 2-meter contact with KC4AAW (EM85). He used a five-element Yagi up 15 feet and 70 W.

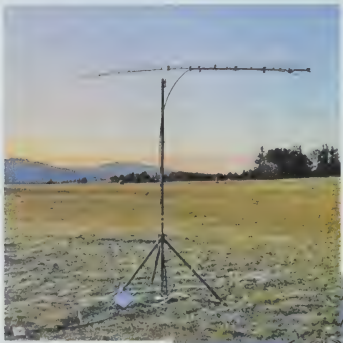


Figure 1 — Gene Shea, KB7Q, set up a portable operation for 222 MHz from grid DN54 in Wyoming. [Gene Shea, KB7Q, photo]

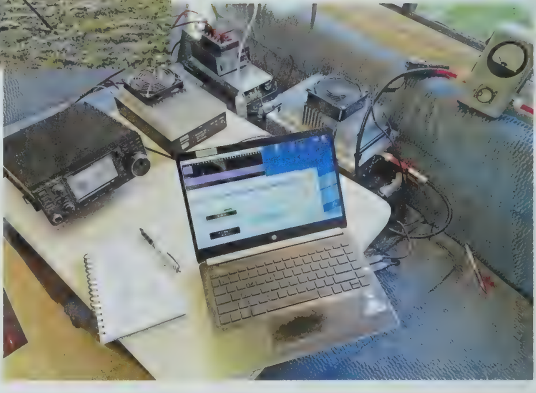


Figure 2 — Gene's, KB7Q, portable 222 MHz MSK144 and EME station. [Gene Shea, KB7Q, photo]

On the Bands

50 MHz. Sporadic E continued through the first 2 weeks of August. Steve, NN4X (EL98), worked 20 European stations on August 1. On August 2, he picked up TZ4AM and 5T5PA. On Tuesday, August 3, he worked G1RZN.

Rich, K1HTV (FM18), worked 5T5PA, TZ4AM, 8P6ET, 9Y4D, J35X, and others on August 3. On August 4, WA2GFN (FN20) worked W5KDX (DM65) on SSB. KE6GFI (DM34) worked from EL96 north to NJ0F (EN34) and west to W7YOZ (CN87) on SSB. On August 10, K9RX (EM84) copied OD5ET and worked G4IFX and another European station on August 12. That appears to be the last of the 2021 transatlantic E_S season.

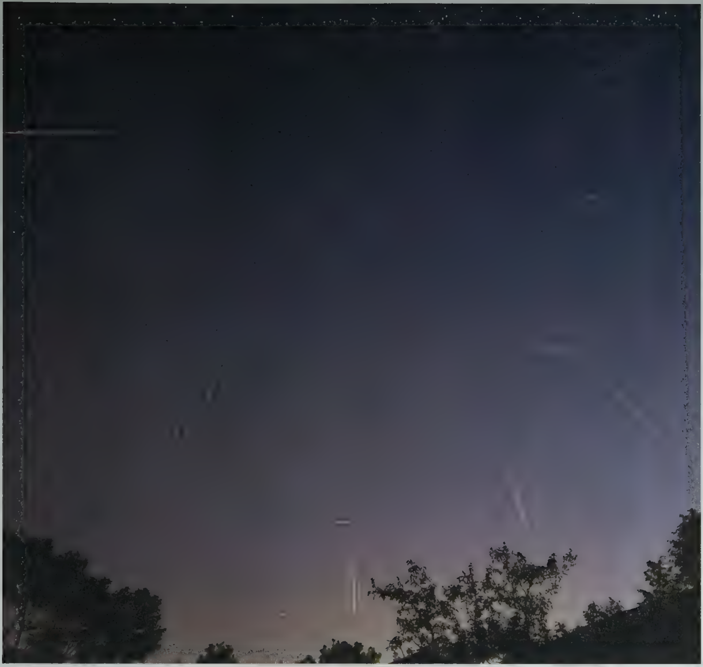


Figure 3 — Composite of 17 separate Perseid meteor shower streaks, ranging in time from 3:07 to 4:24 AM CDT on August 14, 2021. Looking northeast from near Bowman Woods Park in Cedar Rapids, Iowa, skies were clear. The constellation Perseus is at the upper left. The Pleiades star cluster is at the right center, and the constellation Taurus at the lower right. [Gregg Alliss, KE0RBK, photo]

K9RX worked VK4QG on EME on August 14. On August 16, Ron, K3FR (FM18), worked VO1SIX (GN27) on FT8. The last 6-meter E_s in North America reported for August was on the 25 – 26. K3FR reported contacts from Florida to Colorado. I worked KD5M (EM60), W4LID (EM77), and WB4QOC (EM95) on FT8.

144 MHz Tropospheric Opening. A major tropo opening took place the last week of July. Several days of intense tropo associated with a stagnant high-pressure system took place from July 27 – 29. On July 27, WQ0P (EM19) worked stations as far as K4RCA (FM06) on 2 meters, with many contacts on 222 and 432 MHz. N0LL (EM09) worked as far as KE8FD (EN80).

I (EM28) worked K9MRI (EN71) and WZ8D (EM89) on FT8 with 50 W and a M2 Yagi. The best day for stations in eastern Kansas was on July 28. WQ0P, K2DRH (EN41), and KA9CFD (EN40) worked many stations. There was strong tropo from Kansas to W4, with K4NKT (EM64), W3CP (EM74) and KC4AAW (EM85) going in my log on FT8, along with many W8 and W9 stations. I worked WA9DU (EM69), filling in EM28 for him. I had a PSK flag from W3IP (FM19) at 1,483 kilometers.

Sam, K5SW (EM25), worked N8DJB (EM77) on SSB. The tropo moved east on July 29. Stations in Alabama worked to W8 and W4. NV4B/R was on from rare grid EM54 and worked stations from Kansas (WQ0P) to Wisconsin (KO9A).

On August 4, a rare late-season 2-meter E_s opening occurred. WZ1V (FN31) worked KA9CFD (EN40) at +21 dB, as well as K0TPP (EM48) and W5LDA (EM15) around 2300Z. Gary, N2AMC (FN30), logged W5LDA at 0032Z at 2,051 kilometers. On August 13, Rich, N0HJZ (EN34), worked W1XX (FN41) in Rhode Island on 2-meter SSB on meteor scatter "on a 15-second burn." He noted that there was few people on 144.200 MHz SSB or CW.

On August 18, FG4ST (FK96) decoded CT1ETL/1 (IM58), calling CQ on 144.174 MHz FT8 at 2232Z at –20 dB. FG4ST was working EA8 on tropospheric propagation across the Atlantic. A two-way contact would have achieved the Brendan Shields award which, according to Irish Radio Transmitters Society, "will be awarded to each of the operators of the two amateur radio stations which first establish two-way communication between the continents of Europe and America (North or South) within the 2 Metre Amateur Band [using an all-terrestrial, non-artificial means of propagation]." For more information about the Brendan Awards, consult Ev Tupis', W2EV, article, "The Brendan Awards: Insights for the New Millennium," from the August 2002 issue of *QST.*

The tropo continued through August 20. Ramsey, NP3XF, worked EA8BPX, EA8CTK, and EA8CXN on 144.250 MHz SSB. On August 28 – 29, K7ULS worked 20 stations on EME in the Russian EME contest, including TA1D at 0904Z at –27 dB.

222 MHz. K7ULS (DN41) worked W0VTT (EN33) on MSK144 on August 6 at 1134Z. The contact took an hour to complete.

432 MHz. WQ0P (EM19) worked K4RCA (FM06) on July 28 using FT8 tropo at –8 dB.

Here and There

With inspiration from Francis, KV5W, Jim, K5ND, has written an article to help those just learning about the FFMA with a list of resources to assist in achieving this distinguished award. You can find it at **www.k5nd.net/2021/08/fred-fish-memorial-award-ffma**.

Convention and Hamfest Calendar

A = AUCTION
D = DEALERS / VENDORS
F = FLEA MARKET
H = HANDICAP ACCESS
Q = FIELD CHECKING OF QSL CARDS
R = REFRESHMENTS
S = SEMINARS / PRESENTATIONS
T = TAILGATING
V = VE SESSIONS

Abbreviations

Spr = Sponsor
TI = Talk-in frequency
Adm = Admission

Alabama (Montgomery) — Nov. 20 D F H Q R S T V
8:30 AM – 2 PM. *Spr:* Montgomery ARC. Alcazar Shrine Temple, 555 Eastern Blvd. *TI:* Call W4AP 146.84 (123 Hz). *Adm:* $8, includes one admission and ticket. **w4ap.org/marc/hamfest**

Arizona (Marana) — Nov. 13 D F H Q R S T V
7 AM – 1 PM. *Spr:* Oro Valley ARC. Marana Middle School, 11279 West Grier Rd. *TI:* See website. *Adm:* $5. **Tucsonhamradio.org**

Arizona (Mesa) — Dec. 4 D F H Q R S T V
7 AM – 3 PM. *Spr:* Superstition ARC. Superstition Springs Center, 6555 E. Southern Ave. *TI:* 147.120+ (162.2). *Adm:* $5, kids under 12 free. **superstitionsuperfest.org**

Florida (Ocala) — Dec. 4 D F H Q R T V
7:30 AM – 3 PM. *Spr:* Silver Springs Radio Club. First Christian Church, 1908 East Ft. King St. *TI:* 146.610 (123 Hz). *Adm:* $10. **k4gso.us**

Florida (Pinellas Park) — Nov. 13 D F H R T V
8 AM – noon. *Spr:* St. Petersburg ARC. Freedom Lake Park, 9990 46th St. N. *TI:* 147.06 (no PL). *Adm:* Free. Email: **kc1yl@yahoo.com**

ARRL WEST CENTRAL FLORIDA SECTION CONVENTION

December 10 – 11 Plant City, Florida
D F H Q R S T V
Fri. 1 PM – 6 PM, Sat. 8 AM – 4 PM. *Spr:* Florida Gulf Coast Amateur Radio Council. Strawberry Festival Expo Building, 301 Berryfest (was N. Lemon). *TI:* 145.410 (131.8 Hz). *Adm:* $9 Advance, $10 door. **www.fgcarc.org**

ARRL CENTRAL DIVISION CONVENTION

November 13 – 14 Fort Wayne, Indiana
D F H Q R S V
Sat. 9 AM – 4 PM, Sun. 9 AM – 2 PM. *Spr:* Allen County Amateur Radio Technical Society. Allen County War Memorial Coliseum, 4000 Parnell Ave. *TI:* 146.880 (no tone). *Adm:* $6 both days, $3 Sun. **www.fortwaynehamfest.com**

Louisiana (Harahan) — Nov. 13 D F H R S T V
8 AM – 1 PM. *Spr:* Crescent City Amateur Radio Group. VFW Hall, 1133 Hickory Ave. *TI:* 146.82 (114.8 Hz). *Adm:* $5. **ccarg.org**

Michigan (Troy) — Dec. 5 D F H R V
8 AM – noon. *Spr:* L'Anse Creuse ARC. Balkan American Community Center, 1451 East Big Beaver Rd. *TI:* 147.08 (100 Hz). *Adm:* $10. **www.n8lc.org**

Mississippi (Ocean Springs) — Nov. 12 – 13 D F H Q R S V
Fri. 4:30 PM – 8 PM, Sat. 8 AM – 3 PM. *Spr:* Jackson County ARA. St. Martin Community Center, 15008 Lemoyne Blvd. *TI:* 145.110 (123 Hz). *Adm:* $5. **www.jcmsara.com**

Missouri (Brookline) — Nov. 13 D F H R S V
8 AM – 1 PM. *Spr:* Nixa ARC. The Barn House Event Center, 5484 W. Sunshine St. *TI:* 147.015 (162.2 Hz). Adm: $10. **smlrs.files.wordpress.com/2021/07/2021-nixa-arc-hamfest-flyer_reva.pdf**

Nebraska (Norfolk) — Nov. 20 D F H R S V
8:30 AM – 2 PM. *Spr:* Elkhorn Valley ARC, Inc. CHC Hall, 105 Elm Ave. *TI:* 146.73 (131.8 Hz). *Adm:* $5. **qsl.net/evarc**

New Jersey (Fair Lawn) — Nov. 26 D H R
5 PM. *Spr:* Fair Lawn ARC. Fair Lawn Senior Center, 11-05 Gardiner Rd. *TI:* 145.470 (167.9 Hz). *Adm:* $2. **auction.fairlawnarc.org**

New York (Hicksville) — Nov. 14 D F H Q R S V
9 AM – 1 PM. *Spr:* Long Island Mobile ARC. Levittown Hall, 201 Levittown Parkway. *TI:* 146.850 (136.5 Hz). *Adm:* $6. Email: **k2knb@arrl.net**

North Carolina (Benson) — Nov. 21 D F R T V
8 AM – 1:30 PM. *Spr:* Johnston ARS. American Legion Building, 605 N. Wall St. *TI:* 147.270 *Adm:* $9 Advance, $10 door. **www.jars.net/jarsfest-2021**

Ohio (Delta) — Dec. 4 D F H R V
8 AM – 11 AM. *Spr:* Fulton County ARC. Villadelta Memorial Hall, 401 Main St. *TI:* 147.195. *Adm:* $5. **k8bxq.org/hamfest**

VIRTUAL ARRL WISCONSIN STATE CONVENTION

November 13, Online
9:30 AM – 4:30 PM. Wisconsin ARES/RACES Conference. *Adm:* Free. **www.wi-aresraces.org**

Volunteer Monitor Program Report

The Volunteer Monitor (VM) Program is a joint initiative between ARRL and the FCC to enhance compliance in the Amateur Radio Service. This is the August 2021 activity report of the VM Program.

◆Licensees in Pawcatuck, Connecticut; Wamego, Kansas; Valley Cottage, New York; Long Valley, New Jersey; Columbia, South Carolina, and Maryville, Tennessee, were sent advisories concerning operation on frequencies that were set aside for Haiti earthquake emergency communications by the International Amateur Radio Union (IARU) Region 2 Emergency Coordinator.

◆Licensees in Prineville, Winston, Silver Lake, and Roseburg, Oregon; Sioux Falls, South Dakota, and Houston, Texas, were sent advisories concerning failure to identify, as required by Section 97.119(a) of the FCC Amateur Radio Service, pursuant to a nationwide rule compliance review of operations on 3.819 MHz and 3.953 MHz.

◆A former licensee in Seabrook, Texas, was sent an advisory concerning operation with an expired license.

◆An FT8 operator in Orion, Michigan, was sent an advisory reminding him of the 200 W power limit on 30 meters.

◆A licensee in New Caney, Texas, was sent a final notice that his case was being referred to the FCC for license revocation or deletion of voice privileges from his license.

◆A Good Operator commendation was sent to an operator in Roseville, California, for Exemplary Amateur Procedure on May 21, 2021, during the 40-meter California Rescue Communications Net.

◆The revised total for VM monitoring in July was 5,746 hours — the highest number of hours monitored since the inception of the VM Program.

The IT staff at ARRL Headquarters completed work on an automated system for Volunteer Monitors to report monthly monitoring hours and incident reports. — *Thanks to Volunteer Monitor Program Administrator Riley Hollingsworth, K4ZDH*

A Look Back

QST
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January 1972
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OFFICIAL JOURNAL OF THE ARRL
ARRL

Gimmicks and Gadgets

A Crystal Filter for the Drake R-4B

BY DAVID SUMNER,* K1ZND

HERE IS an easy (though expensive) modification which may be performed on the Drake R-4 series of receivers to add a crystal filter. No holes need be drilled and the receiver can be restored to its original condition in less than an hour. The modified receiver has an i-f system with a 6-dB bandpass of approximately 2.2 kHz and a 6:60-dB shape factor of 1.5:1.

The R-4 is a dual-conversion receiver with a four-pole, 6-kHz-wide crystal filter in the first i-f stage (5645 kHz). The purpose of this filter is to provide immunity to out-of-band signals and to assure adequate image rejection which might otherwise be a problem in a receiver with a 50-kHz second i-f. The companion T-4XB exciter/transmitter uses two 8-pole crystal filters at 5645 kHz – one for each sideband. If provision is made for impedance matching, it is possible to use the 8-pole transmitter filters in the receiver first i-f stage. The combination of the sharper crystal filter in the first i-f and the *LC* filter in the second i-f provides excellent selectivity for ssb operation.

Components

The 8-pole filters are available from the R. L. Drake Company at a cost of approximately $80. Included in the package are two filters, a switch, and a mounting bracket. Additionally, a set of matching transformers is required (T2 and T3 in the T-4XB). These cost approximately $8 for the pair. The only other items needed are three feet of shielded cable (RG-174 or equiv.), a metal box, and three 1/4-inch-dia rubber grommets. Any aluminum box larger than 2 1/2 × 3 × 3 inches will be satisfactory.

Step-by-Step Procedure

1) Mount the switch, bracket, and filters in the enclosure as shown in the photograph. Include two grommets on the rear of the box.

2) Route a pair of 18-in. coaxial cables through the grommets on the rear of the enclosure and connect the center conductor of each cable to the center lug of each switch pole. Connect the shields of both cables to the nearest ground lug, respectively.

3) Remove the receiver top and bottom covers.

4) Locate T5 and T6 (the filter matching transformer and the existing crystal filter). Make a sketch of the connections to these transformers (for later reference).

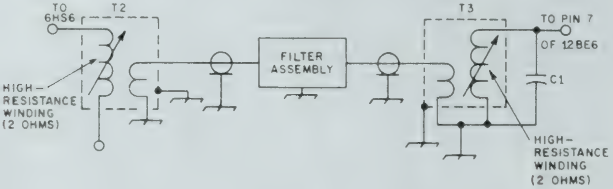
TO 6HS6
T2
HIGH-RESISTANCE WINDING (2 OHMS)
FILTER ASSEMBLY
T3
TO PIN 7 OF 12BE6
C1
HIGH-RESISTANCE WINDING (2 OHMS)

Fig. 1 – Circuit diagram of the modified i-f transformer section of the R-4B receiver. C1 is a 27-pF disk ceramic capacitor in the R-4A. The R-4B uses a 21-pF capacitor. The filter assembly consists of two filters, a ceramic switch, and a mounting bracket. T2 and T3 are the T-4XB transformer designations which replace the receiver T5 and T6 respectively.

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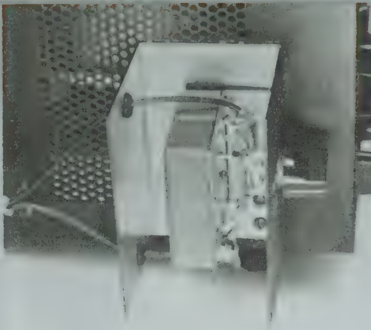
* P.O. Box 17401, West Hartford, CT 06117.



Inside view of the filter assembly built by K1JHX. The box is homemade. Two of the screws for securing the receiver top cover are used to hold the assembly in place. Press-on decals and a Drake knob add a final touch.

5) Disconnect all of the leads to T5 and T6, then remove the transformers. It is not necessary to break or drill anything; the transformers are held in place with a pair of spring clips.

6) Install the new T2 and T3 (T-4XB nomenclature) transformers where T5 and T6 were mounted. T2 replaces T5 and T3 replaces T6. Note that in both cases the high-resistance windings (about 2 ohms) of both transformers are nearest the tube socket to which they are connected. See Fig. 1. The low-resistance windings of each transformer face each other.

7) Reconnect all of the wires and components to the lugs on both transformers. *Exception:* Omit the connections between the two transformer low-resistance windings.

8) Position a rubber grommet in the spare jack hole on the rear chassis apron. Route the shielded wires from the filter box through the grommet and along the chassis to the new i-f transformers. Connect these cables to the i-f transformers as shown in Fig. 2. The center lugs on the transformers are not used. The lugs to which the shields are connected are then grounded with a short piece of hookup wire.

Alignment

Set the receiver tuning dial to position one of the crystal calibrator markers in the middle of the passband. Select either USB or LSB with *both* the passband tuner and the crystal-filter switch. Adjust the **PRESELECTOR**, T2, and T3 for maximum S-meter reading. This condition occurs with the transformer slugs nearly all the way out. There should be no noticeable decrease in sensitivity or overall gain after the modification is completed.

Operation

The crystal-filter switch must be placed in the proper position for the mode of operation. The 4.8-kHz selectivity position of the passband switch is limited by the crystal filter, but the receiver is still usable for a-m reception.

The additional selectivity provided by the filter is noticed mostly while operating ssb during crowded band conditions. However, the cw performance is also improved since there is a substantial reduction of the audio image on the other side of zero beat. The entire modification requires roughly 2 1/2 hours. QST

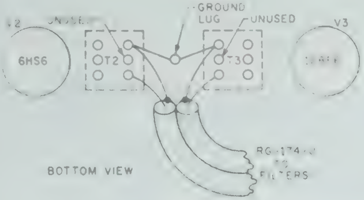


Fig. 2 — The two cables from the filters are routed through the grommet mounted on the rear chassis apron. The center lugs on the transformers are not used.

Bottom view of the modified R-4B. The leads from the filter assembly are routed through a grommet in the rear chassis apron.

Strays

AMATEUR
RADIO STATION
WX2MAP
AMATEUR
RADIO
ASS

During the 1971 Miss America Pageant in Atlantic City, New Jersey, the Southern Counties Amateur Radio Association operated special events station WX2MAP. Taking a breather from Pageant activities, Sheila Bernhagen, Miss Minnesota, paused to say hello to some lucky amateur as W2BZL and WB2QXX look on.

Among recent visitors to Hq. was the Friedman family which includes OM Jordan, WN2OQX; Edward, WN2OQY; Jay, WN2PTL; and 8-year-old Beverly, WN2OQW. The family shares a Globe Scout 680A and a Hammarlund HQ-200 with which they keep Levittown, N.Y. well represented on the Novice bands.

Mayor Graham of Las Cruces, New Mexico, took time out during a city council meeting recently to present a certificate of appreciation from the regional Office of Civil Defense to George and Rose Stewart, K5YRY and WA5ALX, for providing communications during emergencies.

As part of the Union County, Indiana, Sesquicentennial Celebration, local amateurs manned special events station WS9UCI September 19-26 on 160 through 10 meters. Shown here are W9LVH and XYL WN9HGN. A commemorative QSL is available via W9LVH.

Here's a group of contest/DX types really "with it" snapped during a recent impromptu gathering hosted by W1CW. (l. to r.) bottom, WA8TBQ, W8FAW, WA1KQM, W1CW; top, K1ZND, W1BGD, WA8VRB, W1FBY.

January 1972

Celebrating Our Legacy

An Airman Influenced by Radio

Fifty years ago, I was on the last leg of my 4-year enlistment in the US Air Force (USAF), stationed at the Offutt Air Force Base in Omaha, Nebraska. I enjoyed operating QRP CW from my barracks room with a TEN-TEC Power-Mite 2 and a 20-meter dipole strung to a tree.

Back then, ham radio exams involved quite a bit of studying to learn electronics theory and draw schematics. I was fascinated with radio, and soon after graduating high school, I enlisted in the USAF as an Electronics Technician. After finishing Air Force Technical Training at the Keesler Air Force Base in Biloxi, Mississippi, I worked in the Precision Measurement Equipment Laboratory (PMEL) at a number of duty stations, repairing and aligning test equipment like meters, oscilloscopes, and signal generators. I worked for various companies in that capacity for many years after.

I never thought I wanted to operate CW, so instead of becoming a Novice operator, I earned my Technician-class license and operated 2-meter AM. A few years later, I earned my Amateur Extra-class license and got bit by the CW bug.

I still enjoy tinkering with homebrew electronic circuits and kits when I'm not making contacts and chasing DX.

Joe Falletta, W6UDO
Terrebonne, Oregon

My Early Years in Radio

In the early 1960s, I would sit next to my father, W7PVD (SK), and listen as he made CW contacts. He eventually gave me a machine that sent Morse code using paper tapes. It had to be wound up because it had no electric motor, and was connected to a one-tube code practice oscillator, which allowed contacts to be made through the holes as the tape rolled. After studying, I was ready for my Novice-class license test. My dad's good friend, W7PKM (SK), gave me the test, and I passed. While waiting for my license to arrive, my dad searched for used gear. He found a Hallicrafters SX-110 receiver and HT-40 transmitter for $100. After many hours of mowing lawns, I earned enough money to afford the station.

After my Novice-class license finally arrived, I worked the world on 15 meters with one crystal and 75 W. I built a 15-meter beam out of thin wall conduit and mounted it on top of 20 feet of 2-inch pipe. I anchored it just outside my bedroom window (where my station was), so I could listen through the window from outside and rotate the antenna by hand to peak the signal.

When I was ready for my General-class license, it took two tries to pass the test. While I was waiting for my new license to arrive, I worked at a Boy Scout camp in New Mexico. I took my Hallicrafters station with me to make nightly contacts with home. My dad finally called to tell me my license arrived.

When I was 15 years old, I joined the US Army Military Auxiliary Radio System (MARS) and passed a lot of traffic. I always seemed to do well on the procedure tests, which checked your knowledge on how to communicate according to the book.

Fifty-five years after earning my Novice-class license and I still have my first Hallicrafters station!

Joe Bronson, WA7HOP
Globe, Arizona
Life Member

Inspired by Build Articles

I built my first amplifier in 1971, closely following the instructions found in "The 'Junker' Amplifier" by Lewis McCoy, W1ICP, in the October 1970 issue of *QST*. Of the three tube choices the article mentioned, I used an 813 and its 10 V filament transformer, probably because I already had one or could easily get one. I distinctly remember the winding of the tank coil, using a piece of plexiglass as a mount after drilling the required holes, and adding a small coil made of ¼-inch copper tubing for the 15- and 10-meter positions. For the most part, it all worked as described. My shielding wasn't great, and I recall being mostly limited to 80 and 40 meters until cable TV arrived. I used this amplifier with my SB-303 and -401 Heathkit twins for many years. I still own the Heathkits!

The December 1970 issue featured the construction article, "A High-Output VFO for a Beginner's Transmitter," by Peter Zilliox, WA3EQK. I never built this one, but often thought about doing so.

Pete was later awarded the call sign K5PZ and moved to southern California. He became well known, especially in the boatanchor community, not only as a collector and meticulous restorer, but as a reliable mentor. He was instrumental in forming and fostering the Vintage SSB Roundtable about 10 years ago, which survives as a cohesive, friendly group that meets weekly.

Sadly, Pete passed away in August 2020. All of us vintage radio enthusiasts in southern California were enriched by knowing him and miss him deeply.

Ron Pollack, K2RP
Encinitas, California

Send reminiscences of your early days in radio to "Celebrating Our Legacy," ARRL, 225 Main St., Newington, CT 06111 or **celebrate@arrl.org**. Submissions selected for publication will be edited for space and clarity. Material published in "Celebrating Our Legacy" may also appear in other ARRL media. The publishers of *QST* assume no responsibility for statements made in this column.

George Benson, N8RU, n8ru@arrl.net

Classic Radio

Troubleshooting a Classic Receiver

If you have a classic vacuum-tube receiver, but it needs some troubleshooting and repairs, be assured that working on a classic receiver is more straightforward than you might think. It just requires an understanding of what goes on inside the radio and a method of finding what needs to be fixed.

Here's a brief review of some basics, an example from the repair bench (see Figure 1), and notes on getting started.

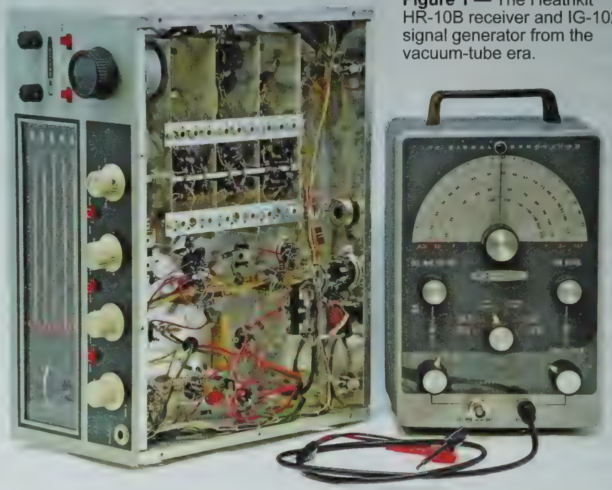


Figure 1 — The Heathkit HR-10B receiver and IG-102 signal generator from the vacuum-tube era.

The Signal Chain

To troubleshoot a superheterodyne receiver, you must know the *signal chain* — the stages through which a radio signal is converted and processed — from the antenna to the speaker.

As seen in Figure 2, a 7.0 MHz signal is tuned and amplified in the RF stage and sent to the mixer. A 7.455 MHz signal is generated by the oscillator and also sent to the mixer. The oscillator's output is ganged with the RF stage, and its frequency always tracks 455 kHz above that being tuned in the RF. So, tuning the radio up the band to 7.1 MHz would result in the oscillator tracking at 7.555 MHz, and so on.

At the mixer, the RF's 7 MHz and the oscillator's 7.455 MHz signals are combined, or *heterodyned*. This produces an output from the mixer that is the difference between the RF and oscillator frequencies — 455 kHz. This is the *intermediate frequency* (IF). Whichever frequency the receiver is tuned to, the IF signal created in the mixer is fixed at 455 kHz, and retains any information, such as AM, CW, SSB, or data contained in the RF's signal.

The mixer's intermediate frequency signal is passed through the IF stage, which is tuned to 455 kHz, increasing selectivity and further amplifying the signal. Filtering to adjust passband width takes place here, and a BFO can be switched in to create the carrier needed to detect CW and SSB.

The signal from the IF stage goes to the detector where AM, CW, SSB, or data are recovered as audio output. The audio signal is sent on to the AF stage for amplification, ending at the speaker or headphone.

The design of the receiver is focused around conversion. The RF tunes over a wide band, being converted to a fixed IF for processing. This simplifies circuity and greatly improves stability, selectivity, and gain. A signal can be converted more than once to enhance performance. Figure 2 shows a single 455 kHz conversion.

Note that most single-conversion communications receivers, including the Heathkit HR-10B in Figure 1, use two IF and AF stages. Figure 2 shows one of each for simplification.

Signal-Substitution

Vacuum-tube circuits carry potentially lethal high voltages. Caution must be exercised when working with power on. Familiarize yourself with safe operating procedures, and follow them when troubleshooting.

Most problems in a receiver — especially if it is dead, intermittent, or has weak output — can be located by starting with a signal generator, working the signal chain in reverse. The AF is tested first, moving back to the detector and IF, the oscillator/mixer, and RF. Output of the stage under test passes to a stage already checked, ending with a confirming tone at the speaker.

The signal generator output is either set to an audio frequency (commonly 400 Hz) for the AF stage, or to the fre-

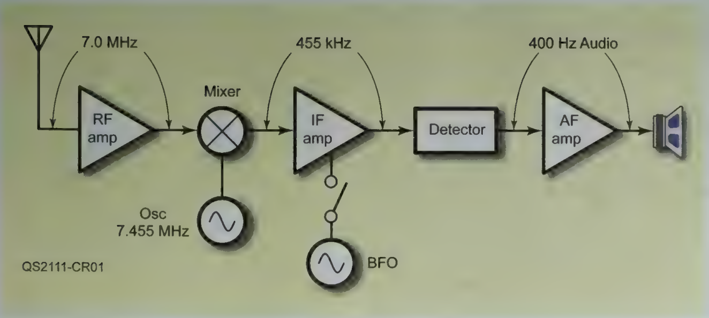


Figure 2 — A signal-chain block diagram.

quency of the RF or IF, and modulated with an audio carrier. Arrows in the block diagram show test points on the signal chain and the frequencies to which the signal generator is set for a radio tuning 7.0 MHz with a 455 kHz IF.

With the signal generator's test lead placed at the input of the stage being checked, the tone will be heard if the stage is functioning properly. If it doesn't pass, or there's distortion from the speaker, correct the problem before moving to the next stage.

At the same time the signal check is being made, the signal generator can be used with a voltmeter to determine if a stage is producing sufficient gain.

When troubleshooting moves into a faulty stage, much of the work involves voltage and resistance measurements reflected in the schematic. Each stage is prone to specific troubles. Having a checklist that prioritizes them speeds the elimination process.

HR-10B Checkout and Repair

My Heathkit HR-10B (see Figure 1) had never been subject to serious neglect or damage. A few minor problems kept it from operating. Solving them only required a method of finding and diagnosing them.

Before troubleshooting, conduct a visual inspection for signs of component failure and faulty wiring. I tested the tubes and cleaned the band switch, controls, and vacuum-tube pins.

As a precaution, I replaced three electrolytic capacitors in the power supply and installed a grounded line cord for safety. There are risks of damage if full ac current is run through a power supply with a shorted electrolytic capacitor, and they can deteriorate over time. Also, an electrolytic that is open or loses capacity can cause under-voltage and audio hum.

When I turned on the HR-10B, the tubes lit, and there were no obvious signs of damage, but once it warmed up, audio was intermittent with a hard tap on the chassis.

Using the signal generator's 400 Hz audio output, the audio transformer and second AF stage passed their separate checks. The intermittent output surfaced in the first AF stage test. I cleaned up some poorly dressed connections with the soldering iron, and checked again. After it passed, I concluded the likely culprit was a solder-starved joint at the coupling capacitor between the audio stages.

I tested the detector and second IF at the input of the second IF. The signal generator was set at the HR-10B's 1681 kHz IF frequency, with a 400 Hz audio carrier. There was weak gain in the speaker. The IF's cathode-bypass capacitor was open and had deteriorated with age. Several solder joints at the vacuum-tube terminals of both stages also looked suspicious. I fixed those issues, and replaced the IF's cathode-bias resistor.

The first IF stage didn't raise any red flags, nor did the mixer/oscillator when I used 3.5 MHz modulated with 400 Hz at the mixer input.

I fed the radio through the antenna jack and switched the signal generator through all five bands, and the RF stage checked okay. I cleaned the band switch again to fix intermittent issues.

Getting Started

To get started in troubleshooting, references from the 1950s or early '60s are essential. Among the best is the 1955 edition of *Elements of Radio Servicing*, by Marcus and Levy. Proceeding from the power supply through each individual stage, circuits are explained down to the component. Troubleshooting is equally detailed.

If looking for a project, consider starting with a basic, single-conversion receiver with a transformer power supply. One like the HR-10/10B is a good choice, with its straightforward circuitry and uncluttered chassis. I would not recommend a first project using radios without transformer power supplies, such as the Hallicrafters S-38 and National SW-54. Their hot-ground chassis pose a serious shock hazard to the inexperienced.

At the bench, all equipment must be at the same ground potential. With a vacuum-tube signal generator, be sure its line cord is correctly polarized. Present-day signal generators can fault out or be damaged by high voltages, so caution is advised. Regardless of vintage, always prevent dc from coming back into the signal generator by having a capacitor in series with the test lead — see the owner's manual.

Al Brogdon, W1AB

100, 50, and 25 Years Ago

November 1921

- The cover art shows a woman wearing a "radio hat," as she listens with earphones.
- The editorial explains that there can never be a competing amateur radio association, when A.R.R.L is "the strongest, the most forward looking, and in the highest regard of our Government."
- "The Protection of Near-by Wiring Against Troubles Caused by Spark Transmitters" offers good advice to the ham who might experience such problems.
- In "Brew Your Own," Robert Hertzberg, 2ABK, tells the story of a small group of hams who had too many "brews" one evening.
- McMurdo Silver instructs readers on "Increasing the Tuning Range of Regenerators."
- W. C. White discusses "Some Operating Notes on the Larger Sizes of Transmitting Tubes."
- "New Apparatus" provides an overview of some of the radio equipment that's now being offered by various manufacturers.
- "Short Wave H. F. Amplification" reports the details of the hookup that Ellery W. Stone (of the Atlantic-Pacific Radio Supplies Co.) demonstrated at the recent Chicago Convention.

November 1921
20 Cents
QST
A MAGAZINE DEVOTED ... WIRELESS ...
"A WIRELESS MESSAGE"
A magazine published monthly by The American Radio Relay League, a national non-commercial organization of wireless amateurs, and devoted exclusively to Citizen Radio.

November 1971

- The cover photo shows the new repeater antenna of the Northwest Florida FM Association being ferried into place atop a 150-foot-high water tower by a helicopter.
- The editorial, "More Ham Bands?," discusses international radio conferences and the possibility of getting some new bands in the future.
- Douglas A. Blakeslee, W1KLK, presents information on "AC-Operated Regulated DC Power Supplies for Transistorized Rigs."
- George Grammer, W1DF, talks about "Interpreting SSB Linear Amplifier Peak and Average Power."
- Jack Gelfand, K2BMI, explains how to modify the HW-100's selectivity to result in "The HW-100 and 1/2."
- Lewis G. McCoy, W1ICP, shares how to build "A Low-Cost Tilt-Over Tower."
- Doug DeMaw, W1CER, explains "How to Tame a Solid-State Transmitter" whose unwanted radiation might be causing the neighbors to have an interference in their TV reception.
- Eugene Pearson, W3QY, presents "A WWVL Receiver" that will receive signals in the 20 kHz range.
- In "Two Possible Explanations for LDEs," C. R. Clark, WB4OBZ, looks again at the phenomenon of long-delayed echoes of radio signals.

QST
November 1971
75 Cents
amateur radio
OFFICIAL JOURNAL OF THE ARRL

November 1996

- The cover photo shows the picturesque location of the Portland (Maine) Amateur Wireless Association's Field Day operation as W1KVI.
- The editorial discusses the importance of ham radio as a "Community."
- "The Truth About Contesters," by Patty Winter, N6BIS, takes a look at the 1996 World Radiosport Team Championship.
- Ronald Lumachi, WB2CQM, provides tips on "Recycling TV Antennas for 2-Meter Use."
- In Part 2 of "Get on 440-MHz ATV!," William Sheets, K2MQJ, and Rudolph F. Graf, KA2CWL, explain how to build a "2-W, 3-Channel ATV Transmitter."
- Tom Atkins, VE3CDM, reports on "*Ham Radio '96* at Friedrichshafen," a huge ham gathering.
- Tom Spann, WD0HBR, shares a brief history and appreciation of "The FCC Grand Island Monitoring Station," on the occasion of its closing.

QST
devoted entirely to
AMATEUR RADIO
Official Journal of The American Radio Relay League
QST compares: 2-meter FM mobile transceivers
Build a 440-MHz ATV transmitter
Build a power attenuator
Turn old TV antennas into 2-meter Yagis
Plus...
• The human side of WRTC-96
• Understanding ACARS
Field Day 1995 Results!

Silent Keys

It is with deep regret that we record the passing of these radio amateurs:

•WB1AST	**Smith**, Richard P., Marlborough, MA
K1BIX	**Plush**, Rusty E., Cornwall, PA
K1CVP	**Evans**, Richard W., Port Charlotte, FL
N1EID	**Bacci**, Joy C., Avon, CT
W1EW	**Johnston**, John J. "Jack," Jr., Stoneham, MA
♦N1IA	**Dutcher**, Barry C., Holly Springs, NC
AA1N	**Palmquist**, Philip E., Jr., Coventry, RI
KB1OWW	**Despres**, Joseph R., Fort Kent, ME
W1TOA	**Lambert**, Wayne M., Weymouth, MA
KB1YYG	**McFadden**, Colin J., Bristol, CT
K1ZVP	**Colinan**, David, Barrington, RI
K2ABX	**Fisher**, Paul A., Apalachin, NY
N2BJW	**Fusare**, Scott T., Burlington, VT
N2BR	**Raymer**, Bobby A., Cookeville, TN
KB2FE	**Linsky**, Edward W., Old Bridge, NJ
AA2GT	**Yulke**, David M., The Villages, FL
W2JHH	**Hamilton**, Jerry H., Clarkesville, GA
WA2KAY	**Luciani**, Thomas A., Bethpage, NY
KB2KNR	**Cunha**, Jose F., Newark, NJ
N2LHV	**Van Horn**, Martin, Leesburg, FL
WA2NJW	**Landau**, Gary S., Marietta, GA
W2NVZ	**Erskine**, Robert J., Rochester, NY
♦WB2UKX	**Biedricki**, Edward, II, Ocala, FL
♦WA2URK	**Swiatlowski**, Edward J., Camillus, NY
WB2WPQ	**Bianchi**, Richard, Lodi, NJ
•W2YMG	**Felice**, Nicholas R., Mahwah, NJ
•K3CS	**Freeman**, Peter, Los Angeles, CA
KC3DPE	**Boyer**, Doreen A., Kutztown, PA
N3EFD	**Goida**, Nicholas, Freeland, PA
•W3EZG	**Borkenhagen**, Gil, Port Charlotte, FL
♦W3KT	**DeNuzzo**, Frank, Gainesville, FL
W3TTT	**Cotton**, Joseph B., Baltimore, MD
KB3WKT	**Horton**, Amanda M., Dover, DE
W4BDA	**Pritchett**, John S., Crossville, TN
KF4BHP	**Shirah**, Aaron L., Geneva, AL
WB4BML	**Player**, Charles E., Jr., Macon, GA
♦WB4CIJ	**Boardman**, Allen H., Maryville, TN
WB4DNK	**Bratton**, James R., Winston-Salem, NC
KK4FAE	**Brady**, George W., Winston-Salem, NC
♦W4FRX	**Bishop**, Robert J., Easton, MD
N4JBK	**Barnes**, Joe, Jacksonville, FL
KC4KCY	**Erskine**, George, Vienna, VA
W4KUM	**Baine**, Samuel N., Lake Wales, FL
•WA4MJK	**Kinzer**, Robert L., Winston-Salem, NC
W4MTT	**Helm**, Howard C., Rich Creek, VA
WB4PHC	**Cartlidge**, David R., Chattanooga, TN
K4RHB	**Burns**, Robert H., Madison, AL
K4ROZ	**Schwartz**, Dale M., Atlanta, GA
KD4RYS	**Turpin**, Kenneth E., Gordonsville, VA
KI4SR	**Carr**, Herman J., Chadbourn, NC
WA4TB	**Brown**, Tommy, Dalton, GA
AD4TO	**Belue**, Bobby F., Tuscumbia, AL
•KC4UEC	**Bibby**, Richard E., Brandon, FL
KR4UK	**Harrelson**, Rodney R., Whiteville, NC
♦KE4VJM	**Hayes**, Anna, Rockwood, TN
•N4VUS	**Ferguson**, Russell N., Kingsport, TN
WB4VWZ	**Sloan**, Thomas H., Washington, NC
K4WHL	**Lucado**, William H., Davie, FL
K4WTV	**McCann**, John F., Jr., Myrtle Beach, SC
•KG4WTW	**Byrge**, Harry, Huntsville, TN
KN4WZQ	**Scrimager**, Jerry L., Nancy, KY
KE4YHY	**Elrod**, Donald M., Arab, AL
♦AC4ZO	**Wittich**, Jeff A., Cary, NC
WO5A	**Chaloner**, Roy L., Murfreesboro, AR
•KA5AGK	**Lewis**, Norma D., Clovis, NM
♦W5AHD	**Huff**, Carroll E. "Rusty," Lawton, OK
AJ5B	**Oravecz**, Kalman I., Socorro, NM
KI5CAD	**Barrios**, Albert, Jr., Plano, TX
KE5CTZ	**Ewing**, James J., Azle, TX
N5DW	**White**, David W., Norman, OK
N5HCX	**Littleton**, C. Max, Albuquerque, NM
W5IDN	**Newman**, Garland G., Murphy, TX
K5JLS	**Mann**, J. T., Hulbert, OK
K5KPK	**Kauffman**, Kwang, Rio Rancho, NM
KC5KXY	**Kent**, La Rae J., Christoval, TX
AC5LH	**Yenni**, Salvador J., Jr., Ponchatoula, LA
KG5MWM	**Ohse**, Richard A., Newalla, OK
KM5NL	**Noakes**, R. K., Fayetteville, AR
W5NQZ	**Radway**, Stephen R., Paris, TX
KC5ODW	**Jump**, Paul W., Tulsa, OK
N5OJ	**Jeffcoat**, Owell, Lamesa, TX
W5ONL	**Sisson**, John S. "Dick," Jr., Garland, TX
W5PNM	**Baade**, Duane R., Lewisville, TX
KD5SZ	**Rogers**, William M., Anadarko, OK
W5VAY	**Seamans**, Fred H., Ponca City, OK
•W5VZF	**Akers**, Jimmy D., Starkville, MS
K5WDS	**Sutherland**, William D. "Satch," Theodore, AL
♦K6AGC	**Ankerbrand**, Barbara W., Fredericksburg, VA
WA6AGL	**Neiswonger**, Richard A., Buena Park, CA
N6AJV	**Krock**, Frederick H., Danville, CA
♦WB6APH	**Howell**, Dorothy "Dotti," Canoga Park, CA
KD6GMM	**Brown**, John B., III, Montgomery, TX
♦W6KIT	**Mullin**, Kit E., Honolulu, HI
N6MNL	**Robinson**, Robert L., El Sobrante, CA
WA6N	**Benoit**, Louis A., Jr., Mi Wuk Village, CA
WW6O	**Gilbertson**, Rolf "Orin," Carson City, NV
AL6U	**Ettelt**, Mark, Las Vegas, NV
KI6WNW	**Melroy**, Stephen H., Desert Hot Springs, CA
K6YBV	**Ringwald**, Robert S., Placerville, CA
♦KB6ZE	**Griffitts**, Robert W., Covina, CA
♦WA7ACA	**Brandenburg**, George C., Silver City, NM
AA7AD	**Anhorn**, Rick C., Mead, WA
W7BWY	**Atwood**, Bob M., Guthrie, OK
N7DLW	**Riley**, Morgan S., Phoenix, AZ
KL7IKX	**Dickinson**, Douglas P., Anchorage, AK
WC7N	**Ingram**, Rodney R., Gold Beach, OR
KE7NEG	**Armentrout**, David L., Mesa, AZ
KG7ODH	**Hunt**, Dennis W., Yakima, WA
K7PRQ	**Mriss**, Michael A., Phoenix, AZ
KC7QKS	**Williams**, Carol H., Jr., Laveen, AZ
AF7RX	**Buffington**, John R., Vancouver, WA
K7SBK	**Gerbens**, Albert R., Jr., Mesa, AZ
♦K7SEC	**Douglas**, Phyllis S., Marana, AZ
KE7TQW	**Noid**, Benjamin M., Sr., Kimball, SD
WB7VBE	**Ayers**, Arnold L., Jr., Idaho Falls, ID
W7YDW	**Woods**, Richard L., Tucson, AZ
K7ZHZ	**Vaughan**, William L., III, Glendale, AZ
N8AD	**Stefanelli**, Leonard A., Fairview, PA
•KC8EJX	**Patterson**, Patrick A., Wilmot, OH
KD8KWD	**Robinson**, John W., III, Tallmansville, WV
♦♦W8LLY	**Stone**, Fred, Bellbrook, OH
KC8QOF	**Hartmeyer**, Joseph J., Maryville, TN
KE8QR	**Peoples**, Clifton M. "Pete," Jr., Clayton, OH
W8RZN	**Higgins**, Francis "Frank," Jr., Toledo, OH
W8TXX	**Isham**, James R., East Lansing, MI
K8YPA	**Lemaster**, Roger S., Lyndhurst, OH
WB9BZC	**Capello**, Pearl, Milwaukee, WI
•K9CAK	**Norman**, Ken J., Jr., Racine, WI
K9CDH	**Hayes**, Clifton D., Jr., Blanchard, OK
N9EVM	**Richards**, Norman L., Seymour, IN
KC9FMS	**Tovo**, Michael A., Dundas, IL
N9FO	**Creek**, James "LeRoy," Frankfort, IL
WA9JLV	**Taflove**, Allen, Skokie, IL
WA9JOB	**Harvey**, Nels W., Mequon, WI
N9KAP	**Yoder**, Nellie O., Elkhart, IN
K9MDS	**Denton**, Mayford, Lebanon, IN
KB9MGG	**Melton**, Richard D., North Vernon, IN
♦K9NF	**Ault**, John H., Kenosha, WI
KG9NLP	**Zuehlke**, Donald J., Sun Prairie, WI
KA9OTR	**Holivay**, Robert L., Sikeston, MO
♦WB9RVL	**Tapp**, Larry W., Charlestown, IN
•KB9SQW	**Poynter**, Randall L., Shelbyville, IN
WI9X	**Stoeber**, James R., Belleville, IL
KF9XL	**Kraak**, John G., Waukesha, WI
•AA0AV	**Irvin**, Ben F., Jr., Tulsa, OK
WD0BQG	**Rice**, M. W., Scottsbluff, NE
K0CQ	**Johnson**, Gerald N. "Jerry," Ellsworth, IA
WB0DHS	**Marthaler**, Martin A., Marshall, MN
WE0G	**Haye**, Harold Keith, Centerview, MO
N0GAB	**Novak**, Edward "Butch," Kansas City, KS
W0GAW	**Jones**, Doris B., Overland Park, KS
♦N0GE	**Rogers**, Gregory E., Angier, NC
KG0ND	**Kluever**, Norman W., Des Moines, IA
♦K0OHB	**Ashwell**, Wayne C., Saint Louis, MO
W0POT	**Layton**, Donald H., Valley City, ND
KA0PXG	**Williams**, Lawrence "Gale," Springfield, MO
N0XRS	**Yost**, Virgil W., Colorado Springs, CO
•WB0YEA	**Zeiler**, Gale Douglas, Los Angeles, CA
N0YGZ	**Higganbotham**, Thomas E., Magnolia, TX
VE3CNA	**Hogarth**, Gordon H., Scarborough, ON, Canada
VE3MFP	**Laliberty**, Denis G., St. Catharines, ON, Canada
VE7FYU	**Tait**, Henry, West Vancouver, BC, Canada
VK2MBA	**Orbell**, Bernard George, Sydney, NSW, Australia
VK3JKY	**Wilson**, Dave, Stratford, VIC, Australia
DJ3IW	**Linss**, Goetz, Burglengenfeld, Germany
XE1V	**Libin**, Lorne S., Cuernavaca, Morelos, Mexico

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For information on how to list a Silent Key in *QST*, please visit **www.arrl.org/silent-key-submission-guidelines**.

Note: Silent Key reports must confirm the death by one of the following means: a copy of a newspaper obituary notice, a copy of the death certificate, or a letter from the family lawyer or the executor. Please be sure to include the amateur's name, address, and call sign. Allow several months for the listing to appear in this column.

HAM RADIO OUTLET 50 YEARS ANNIVERSARY 1971 2021

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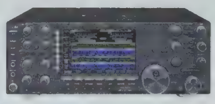

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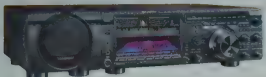
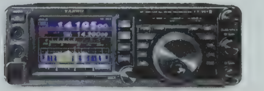


FTDX101MP | *200W HF/50MHz Transceiver*

• Hybrid SDR Configuration • Unparalleled 70 dB Max. Attenuation VC-Tune • New Generation Scope Display 3DSS • ABI (Active Band Indicator) & MPVD (Multi-Purpose VFO Outer Dial) • PC Remote Control Software to Expand the Operating Range • Includes External Power With Matching Front Speaker

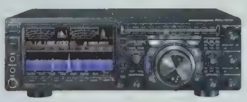
FTDX10 | *HF/50MHz 100 W SDR Transceiver*

• Narrow Band and Direct Sampling SDR • Down Conversion, 9MHz IF Roofing Filters Produce Excellent Shape Factor • 5" Full-Color Touch Panel w/3D Spectrum Stream • High Speed Auto Antenna Tuner • Microphone Amplifier w/3-Stage Parametric Equalizer • Remote Operation w/optional LAN Unit (SCU-LAN10)



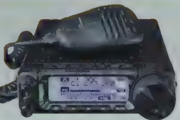
FT-991A | *HF/VHF/UHF All ModeTransceiver*

Real-time Spectrum Scope with Automatic Scope Control • Multi-color waterfall display • State of the art 32-bit Digital Signal Processing System • 3kHz Roofing Filter for enhanced performance • 3.5 Inch Full Color TFT USB Capable • Internal Automatic Antenna Tuner • High Accuracy TCXO



FTDX101D | *HF + 6M Transceiver*

• Narrow Band SDR & Direct Sampling SDR • Crystal Roofing Filters Phenomenal Multi-Signal Receiving Characteristics • Unparalleled - 70dB Maximum Attenuation VC-Tune • 15 Separate (HAM 10 + GEN 5) Powerful Band Pass Filters • New Generation Scope Displays 3-Dimensional Spectrum Stream



FT-891 | *HF+50 MHz All Mode Mobile Transceiver*

Rugged Construction in an Ultra Compact Body • Stable 100 Watt Output with Efficient Dual Internal Fans • 32-Bit IF DSP Provides Effective and Optimized QRM Rejection • Large Dot Matrix LCD Display with Quick Spectrum Scope • USB Port Allows Connection to a PC with a Single Cable • CAT Control, PTT/RTTY Control

FTM-300DR | *C4FM/FM 144/430MHz Dual Band*

• 50W Reliable Output Power • Real Dual Band Operation (V+V, U+U, V+U, U+V) • 2-inch High-Res Full Color TFT Display • Band Scope • Built-in Bluetooth • WiRES-X Portable Digital Node/Fixed Node with HRI-200

FT-2980R | *Heavy-Duty 80W 2M FM Transceiver*

• Massive heatsink guarantees 80 watts of solid RF power • Loud 3 watts of audio output for noisy environments • Large 6 digit backlit LCD display for excellent visibility • 200 memory channels for serious users

FT-818ND | *HF/6M/2M/440 All Mode Portable Xcvr*

• Ultra-Compact/Portable • Multi-Color Easy to See LCD • 208 Memory Channels/10 Memory Groups • Built-in Electronic Keyer • Internal Battery Operation Capability • Two Antenna Connectors • Built-in High Stability Oscillator ±0.5 ppm

FTM-400XD | *2M/440 Mobile*

• Color display-green, blue, orange, purple, gray • GPS/APRS • Packet 1200/9600 bd ready • Spectrum scope • Bluetooth • MicroSD slot • 500 memory per band

FT-70DR *C4FM/FM 144/430MHz Xcvr*

• System Fusion Compatible • Large Front Speaker delivers 700 mW of Loud Audio Output • Automatic Mode Select detects C4FM or Fm Analog and Switches Accordingly • Huge 1,105 Channel Memory Capacity • External DC Jack for DC Supply and Battery Charging

FT-5DR *C4FM/FM 144/430 MHz Dual Band*

• High-Res Full-Color Touch Screen TFT LCD Display • Easy Hands-Free Operation w/Built-In Bluetooth© Unit • Built-In High Precision GPS Antenna • 1200/9600bps APRS Data Communications • Supports Simultaneous C4FM Digital • Micro SD Card Slot

FT-65R | *144/430 MHz Transceiver*

Compact Commercial Grade Rugged Design • Large Front Speaker Delivers 1W of Powerful Clear Audio • 5 Watts of Reliable RF Power Within a compact Body • 3.5-Hour Rapid Charger Included • Large White LED Flashlight, Alarm and Quick Home Channel Access

FT-60R | *2M/440 5W HT*

• Wide receiver coverage • AM air band receive • 1000 memory channels w/alpha labels • Huge LCD display • Rugged die-cast, water resistant case • NOAA severe weather alert with alert scan

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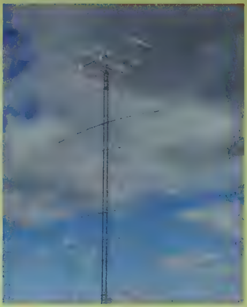

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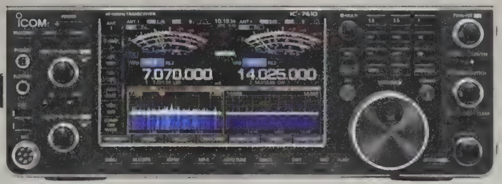
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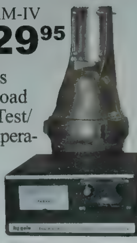


The most popular rotator in the world! For medium communications arrays up to 15 sq. ft. wind load area. 5-second brake delay, Test/Calibrate function. Low temperature grease permits normal operation down to -30 degrees F. Alloy ring gear for extra strength up to 100,000 PSI for maximum reliability. *Precision* indicator potentiometer. Ferrite beads reduce RF susceptibility. Cinch plug plus 8-pin plug at control box. Dual 98 ball bearing race for load bearing strength and electric locking steel wedge brake prevents wind induced movement. North/South center of rotation scale on meter, low voltage control, max mast 2 1/16".

HAM-VI **$909.95** with DCU-2

HAM-VII **$999.95** *with DCU-3*

HAM IV and HAM V Rotator Specifications	
Wind Load capacity (inside tower)	15 square feet
Wind Load (w/mast adapter)	**7.5 square feet**
Turning Power	800 in.-lbs.
Brake Power	**5000 in.-lbs.**
Brake Construction	Electric Wedge
Bearing Assembly	**dual race/96 ball bearings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	26 lbs.
Effective Moment (in tower)	**2800 ft.-lbs.**

TAILTWISTER SERIES II

T-2X **$969.95**

T-2XD2 **$1079.95** with DCU-2

T-2XD3 **$1139.95** with DCU-3

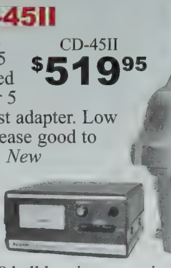
For large medium antenna arrays up to 20 sq. ft. wind load. 5-second brake delay, Test/Calibrate functions. Low temp grease, tough alloy ring gear, indicator potentiometer, ferrite beads on potentiometer wires, weatherproof AMP connectors plus 8-pin plug at control, triple bearing race (138 ball bearings) for large load bearing, electric locking steel wedge brake, North/South center of rotation scale meter, low voltage control, 2 1/16" mast.

MSHD, $149.95. Above tower heavy duty mast support. Accepts 1 7/8-2 5/8" OD.

TAILTWISTER Rotator Specifications	
Wind load capacity (inside tower)	20 square feet
Wind Load (w/ mast adapter)	**10 square feet**
Turning Power	1000 in.-lbs.
Brake Power	**9000 in.-lbs.**
Brake Construction	Electric Wedge
Bearing Assembly	**Triple race/138 ball brngs**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	31 lbs.
Effective Moment (in tower)	**3400 ft.-lbs.**

CD-45II

CD-45II **$519.95**

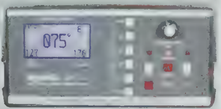


For antenna arrays up to 8.5 sq. feet mounted inside tower or 5 sq. ft. with mast adapter. Low temperature grease good to -30 F degrees. *New* Test/Calibrate function. Bell rotator design gives total weather protection, dual 58 ball bearing race gives proven support. Die-cast ring gear, stamped steel gear drive, heavy duty, trouble free gear train, North center scale, lighted directional indicator, 8-pin plug/socket on control unit, snap-action control switches, low voltage control, safe operation, takes maximum mast size to 2 1/16 inches. MSLD light duty lower mast support included.

CD-45II Rotator Specifications	
Wind load capacity (inside tower)	8.5 square feet
Wind Load (w/ mast adapter)	**5.0 square feet**
Turning Power	600 in.-lbs.
Brake Power	**800 in.-lbs.**
Brake Construction	Disc Brake
Bearing Assembly	**Dual race/48 ball brings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	22 lbs.
Effective Moment (in tower)	**1200 ft.-lbs.**

Hy-Gain Programmable DCU-3
Digital Rotator Controller
DCU-3 -- $519.95

Hy-gain DCU-3 Digital Controller lets you program 6 beam headings! Gives you full automatic or manual control of your hy-gain HAM or Tailtwister Rotators.



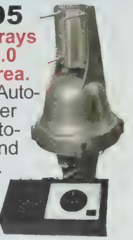
Press a memory button or dial in your beam heading or let *Ham Radio Deluxe* (or other) take control. Your antenna auto rotates precisely and safely to your DX.

DCU-3 automatically jogs your antenna free and safely unlocks it before rotating begins *(great for older rotators with "sticky" brakes)* then turns off your motor before reaching its final heading. Your antenna *gently* coasts to a stop before the brake re-locks -- greatly reducing damaging overshoots and extending rotator life. Simply press *Left* and *Right* buttons for *full* manual control and fine tuning. Bright blue LCD shows current, dialed-in and computer controlled beam headings in one degree increments and your call.

Calibrate lets you accurately match your display to your *true* beam heading. Has USB/RS-232 ports for computer control. Adjustable LCD sleep time. Field upgradeable firmware. 8.5Wx4.3H x9D". 110 VAC. Order DCU-3X for 220 VAC.

DCU-2 Digital Rotator Controller --$479.95
$479.95. Like DCU-3, but less programmable memories. 110 VAC. Order DCU-2X, for 220 VAC.

AR-40 -- $419.95



For compact antenna arrays and large FM/TV up to 3.0 square feet wind load area. Dual 12 ball bearing race. Automatic position sensor never needs resetting. Fully automatic control -- just dial and touch for desired location. Solid state, low voltage control, safe, silent operation. 2 1/16" max mast. MSLD low mast included.

AR-40 Rotator Specifications	
Wind load capacity (inside tower)	3.0 square feet
Wind Load (w/ mast adapter)	**1.5 square feet**
Turning Power	350 in.-lbs.
Brake Power	**450 in.-lbs.**
Brake Construction	Disc Brake
Bearing Assembly	**Dual race/12 ball bearings**
Mounting Hardware	Clamp plate/steel bolts
Control Cable Conductors	**5**
Shipping Weight	14 lbs.
Effective Moment (in tower)	**300 ft.-lbs.**

Replace your Yaesu Rotator Controller

YRC-1 - $399.95

Hygain YRC-1 -- more features, more robust, far less prone to lightning damage. Costs less than repairing!

Easy-to-use -- dial in your beam heading and tap GOTO button, Exclusive 180 degree *AutoReversal*™ for fast longpath operation. All DCU-2 features. Bright blue LCD shows current, dialed-in, computer controlled beam headings, call. USB port for computer control. Extra heavy-duty AC power supply. Fast variable DC motor minimises overshoot. Intuitive menu. Field upgradeable. For Yaesu G-800/1000/2800/G450/650. AC or DC motors.

YRC-3, $499.95. Like YRC-1 and adds 6 memories.

AR-500 Rotator/Controller -- $199.95

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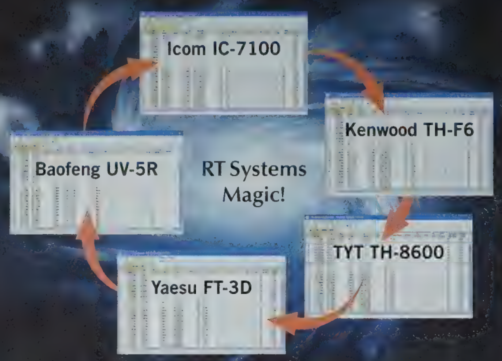

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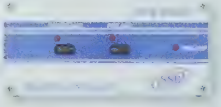

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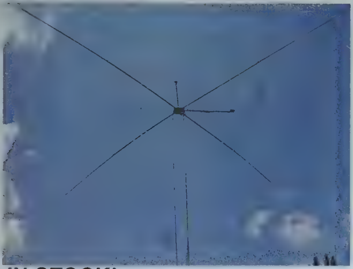

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MFJ-1836H $309.95

6-Band Cobweb Antenna covers 20/17/15/12/10/6 Meters, just 8 lbs., 9x9x1/2 feet, handles 1.5 kW. Horizontally polarized for low noise.

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MFJ 3-inch Cross-Needle SWR/Wattmeter covers HF/VHF/UHF, 1.8 to 525 MHz. Handles 0-200 Watts in three power ranges: 2/20/200W. Separate HF and VHF/UHF power sensors with SO-239 connectors. LED backlight gives excellent night vision. Three color scaled meter. Backlight requires 13.8 VDC or 110 VAC operation. Super compact 5.5Wx3.18Hx5D inches.

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Copy weak, barely readable signals with this MFJ All-Band Transceiver/Preselector. Rejects out-of-band signals, images 1.8-54 MHz. Get up to 20 dB gain. Uses a cascode FET/bipolar transistor for low noise, high gain with a 20 dB attenuator. Connect two antennas to two receivers with SO-239 connectors. Automatically bypass when transmitting to 125 Watts. 6.5Wx2.5Hx4D inches.

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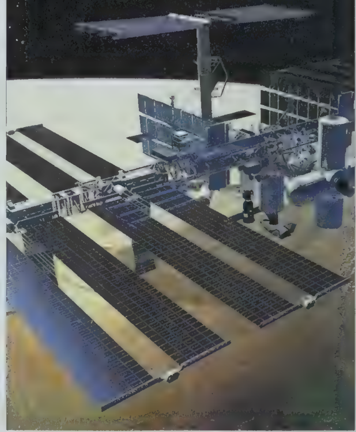

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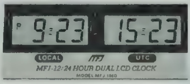

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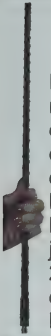

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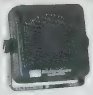

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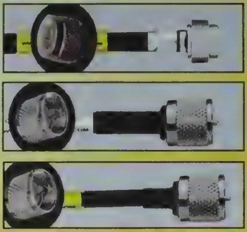

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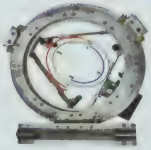

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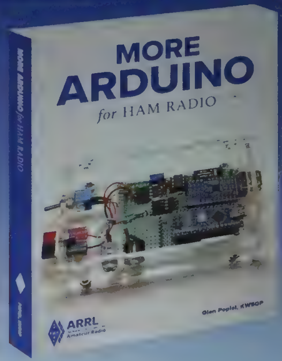

Written by popular author and experimenter Glen Popiel, KW5GP, *More Arduino for Ham Radio* introduces many of the new Arduino boards and add-on modules, followed by an overview of the software, tools, and techniques needed to bring projects to life. Practical projects showcase a wide variety of applications and include how the software "sketches" work.

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It's an efficient, *all band* 102 foot long antenna -- shorter than an 80 Meter dipole. Has 32.5 foot ladder line matching section ending in SO-239 connector for your coax feedline.

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Operate all bands 80-10 Meters with an antenna tuner and even 160M with ground.

Fully assembled with *ceramic* end and fiberglass center insulators. *Hang and Play™* -- add coax, rope to hang and you're on air!

MFJ-1778M, $69.95. *Half-size*, 52 foot *G5RV JUNIOR for limited space.* 40-10 Meters with tuner. Full 1500 Watts.

MFJ All Band Classic Doublet

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MFJ 102 foot *all band* doublet covers 160-6 Meters with balanced line tuner. Super strong custom fiberglass center insulator relieves stress on 100 foot ladder line. *Glazed ceramic* end insulators. 1500 Watts.

RF Isolator

MFJ-915
$49.95

MFJ-915 *RF Isolator* prevents unwanted RF from traveling on the outside of your coax shield into your transceiver. This unwanted RF can cause painful RF "bites" when you touch your microphone or volume control, cause your display or settings to go crazy, lock up your transceiver or turn off your power supply. In mobile installations, stray RF could cause your car to do funny things even blow your car computer. Clear up these problems, plug an MFJ-915 between your antenna and transceiver. 1.8-30 MHz, 1500 Watts. 5x2 inches.

MFJ-919, $74.95. 4:1 current balun,1.5 kW.
MFJ-913, $49.95. 4:1 balun, 300 Watts.

True 1:1 Current Balun & Center Insulator

MFJ-918
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True *1:1 Current Balun/ Center Insulator* forces equal radiator currents in dipoles for true dipole radiation pattern. Reduces coax radiation and field pattern distortion -- your signal goes where *you* want it. Reduces TVI, RFI and RF hot spots. *Don't build a dipole without one!* 50 hi-permeability ferrite beads on high quality RG-303 *Teflon*® coax and *Teflon*® SO-239. 1.5kW 1.8-30 MHz. Stainless steel hardware. 14 gauge stranded copper wire is *directly* connected to your antenna. 5x2 inches. Heavy duty weather housing.

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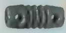
MFJ-1702C, $54.95. 2-position antenna switch, lightning surge protection, center ground. SO-239s.

Lightning surge protectors. MFJ-270,

$29.95. 400W. **MFJ-272, $44.95.** 1500 W. Gas discharge tube shunts 5000 amps peak.< 0.1 dB loss. 1 GHz. SO-239s.



MFJ-16C06, $8.95. 6-pack *glazed ceramic* end/center ant. insulators.

MFJ-16B01, $29.95. Molded high-strength center insulator. SO-239.

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MFJ-18H100, $49.95. 100 feet, 450 Ohm ladder line, 18 gauge copper clad.

80-10 Meter End-Fed Half Wave antenna

Cover all HF bands with one single wire and no tuner!

MFJ-1982HP, $119.95

No tuner needed!
All band 80-10M EFHW antenna

Get-on-the air on all bands 80-10 Meters with just one wire and one support (pole or tree) and no tuner or long counterpoise.

Installs anywhere in minutes! Rugged *insulated*-wire radiator prevents detuning when contacting limbs/branches. *"No-snag"* end insulator slides over branches, leaves.

Toss over a high limb for inverted-V or sloper or go vertical with an inverted-L.

Dark jacketed wire is virtually invisible -- *don't let antenna restrictions keep you off the air!* Great for emergencies.

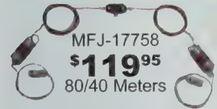
EFHWs naturally resonate on the 1/2-wave fundamental frequency and odd/even harmonics. Covers 80/40/30/20/17/15/12/10 Meters without traps, stubs or resonators.

Broad-band matching transformer at feed point gives SWR so low you may never need a tuner. Compensating inductor optimizes SWR. 800 Watts SSB/CW. 132 feet jacketed antenna wire.

MFJ-1984HP, $99.95. Like MFJ-1982HP but 40-10M. 66 feet jacketed wire.

See www.mfjenterprises.com for 30 Watt QRP and 300 Watt models.

Dual Band Dipoles

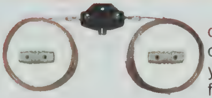


MFJ-17758
$119.95
80/40 Meters

MFJ-17758, $119.95. Operate 80/40 Meters with a short 85 foot dipole. *Full-size* on 40 Meters with ultra-efficient end-loading on 80 Meters. 1500 Watts. Super-strong custom molded center insulator with SO-239 connector and hang hole. Ceramic end insulators. 7-strand, 14 gauge hard copper wire. *No tuner needed!*

MFJ-17754, $79.95. Like MFJ-17758 but is only 42 feet. Operate 40/20 Meters. *Full-size* on 20 Meters, ultra-efficient end-loading on 40 Meters. 1500 Watts.

Single Band Dipoles



MFJ-1779A
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160M, 265 ft.

MFJ-1779B
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80-40M, 135 ft.

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20-6M, 35 ft.

Ultra high quality center fed dipoles give years of trouble-free service. Custom injection-molded UV-resistant center insulator has built-in SO-239 and hanging hole. *Glazed* ceramic end insulators. 7-strand, 14-gauge hard copper antenna wire. 1500 Watts. Use horizontally or as sloper or inverted vee. Simply cut to length with provided cutting chart.

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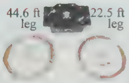

MFJ-2012
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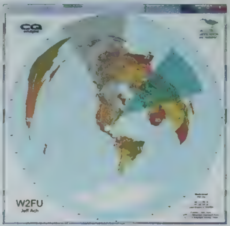

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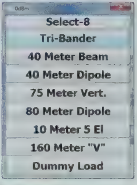

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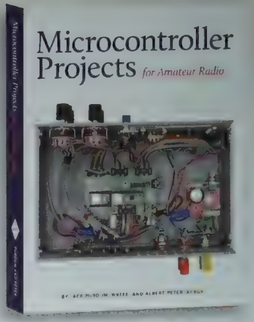

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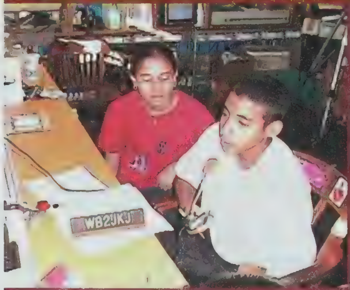

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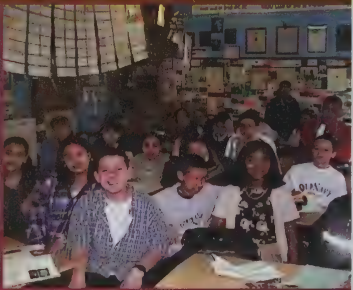

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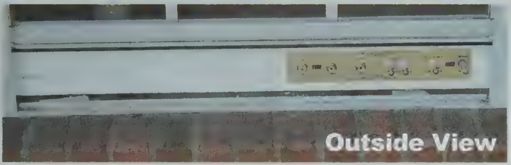
Weather-proof window feedthrough panels bring coax, balanced lines, HF/VHF/UHF antennas, random wire antennas, ground, rotator/antenna switch cables and DC/AC power into your hamshack without drilling through walls!

Inside View



MFJ Weather-Proof Window Feedthrough Panels mount in your window sill. Lets you bring all your antenna connections into your hamshack without drilling holes through walls.

Simply place in window sill and close window. One cut customizes it for any window up to 48 inches. Use horizontally or vertically. Connectors are mounted on inside/outside stainless steel plates and attached to a 4 foot long, $3^{1}/_{2}$ inch high, $^{3}/_{4}$ inch thick pressure-treated wood panel.

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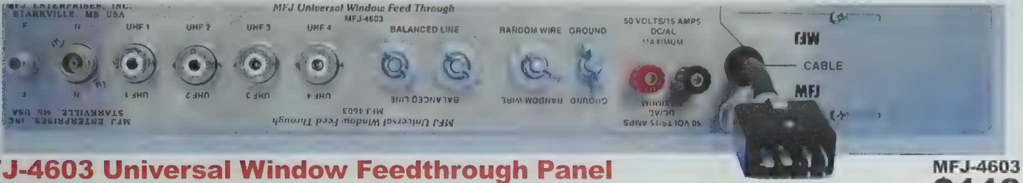

MFJ-4603 Universal Window Feedthrough Panel

MFJ-4603
$119.95

Four 50 Ohm Teflon® SO-239 coax connectors lets you feed HF/VHF/UHF antennas at full legal power limit.

A 50 Ohm Teflon® coax N-connector lets you use any antenna up to 11 GHz, including 450 MHz, UHF, satellite, moon bounce and 2.4/5.8 GHz Wi-Fi antennas.

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A pair of high-voltage ceramic feedthru insulators lets you bring in 450/300 Ohm balanced lines directly to your antenna tuner.

Has random/longwire antenna ceramic feedthru insulator.

5-way binding posts lets you supply 50 Volts/15 Amps DC/AC power to your outside antenna tuners/relays/switches.

Stainless ground post brings in ground connection, bonds inside/outside stainless steel panels together and drains away static charges.

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3 Coax, Balanced Line, Random Wire

Best Seller! 3 Teflon® coax connectors for HF/VHF UHF antennas. Separate high voltage ceramic feed-thru insulators for balanced lines and longwire/random wire, Stainless steel ground post.

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6 Coax

6 high quality Teflon® coax connectors for HF/VHF/UHF antennas. Stainless steel ground post. Full 1500 Watt legal limit.

MFJ-4601
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4 Balanced Line, 2 Coax

4 pairs of high-voltage ceramic feed-thru insulators for balanced lines and 2 coax connectors.

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5 Adaptive Cable Feedthrus™. Pass any cable with connector: 2 cables with large connectors up to $1^{1}/_{4}$ x $1^{5}/_{8}$ inches and 3 cables with UHF/N size coax connectors. Seals out weather.

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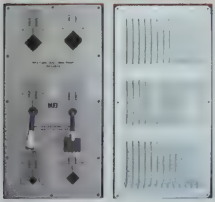
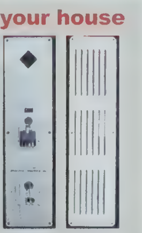
Bring cables through the eave of your house



MFJ-4616
shown with standard full size vent (not included) it replaces. For 6 Cables
$39.95



MFJ-4613
shown with standard half size vent (not included) it replaces. For 3 Cables
$24.95

Replace your standard air vents on the eave/sofitt of your house with these MFJ AdaptiveCable™ Air Vent Plates and...

Bring in coax, rotator, antenna switch, power cables, etc. with connectors up to $1^{1}/_{4}$ x $1^{5}/_{8}$ inches!

Sliding plates and rubber grommets adjust for virtually any cable size to seal out adverse weather, insects and varmints. Use existing vent hole, mounting screws and screw holes.

AdaptiveCable™ Wall Plates

MFJ-4614
For 4 Cables
$49.95

Bring nearly any cable -- rotator, antenna switch, coax, DC/ AC power, etc. -- through walls without removing connectors (up to $1^{1}/_{4}$x$1^{5}/_{8}$ inches). Sliding plates and rubber grommets adjust hole size to weather-seal virtually any size cable.

Includes stainless steel plates for each side of wall, sliding plates, rubber grommets, weather stripping and screws.

MFJ-4612
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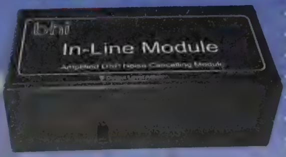
New In-Line Module



- New amplified DSP noise canceling In-Line module
- 8 filter levels 8 to 40dB, tone reduction up to 65dB
- 5 W audio with latest bhi noise canceling
- Use with a passive mono extension speaker
- Audio bypass feature - 3.5mm mono input/output
- Headphone socket - DC power 10 to 16V DC
- Replacement for NEIM1031MKII & ANEM MKII

New DESKTOP MKII

New DESKTOP MKII - 10W DSP noise canceling base station speaker - Now with latest bhi DSP noise canceling technology for even better receive audio - Easy to use rotary controls - 8 DSP filter levels - "Real time" audio adjustment - Suitable for all radios incl. SDR

Dual In-Line

Fully featured amplified DSP noise canceling in-line module - Separate mono or stereo input and outputs - Headphone socket - Latest bhi DSP noise canceling technology - Suitable for all radios, receivers and SDR - Use with headphones and a speaker at the same time

bhi
Dual In-Line
Noise Eliminating Module

NES10-2MK4

- 5W audio power - Latest bhi DSP noise canceling
- Up to 65dB tone reduction
- 8 filter levels 9 to 40dB
- Single function switch for "Off, "On"and "DSP" filter
- Audio overload LED
- Audio bypass feature
- Headphone socket

Compact In-Line

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Compact In-Line Noise Eliminating Module

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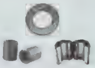

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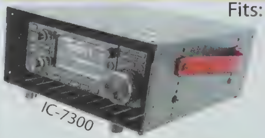

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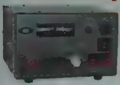

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MFJ-4225MV Switching power supply gives 25A surge, 22A continuous. Adjustable 9-15 VDC output, 85-260 AC input. Large 3" dual Amp/Volt meters, binding posts, cigarette lighter socket. 3.7 lbs., $5^{1}/_{4}$Wx$4^{1}/_{2}$Hx6D".

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MFJ-4125 gives 25A surge, 22A continuous. 13.8 VDC switcher has 5-way binding posts on front and quick connects on back. 3.5 lbs.

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MFJ-4035MV 19.2 lb. transformer, 35A max, 30A continuous. 1-14 VDC out, 110 VAC in. Highly regulated, 1% load, 1 mV ripple. 5-way posts, cig lighter. $9^{1}/_{2}$Wx6Hx$9^{3}/_{4}$D".

25-Amps, $^{\$}134^{95}$

MFJ-4125P. 25A surge, 22A continuous. 13.8 VDC switcher has 2-pair *PowerPoles*$^{(R)}$, 5-way posts, quick connects. 3.5 lbs.

15-Amps, $^{\$}84^{95}$

MFJ-4115. 17A surge, 15A cont. 13.8 VDC. 110/ 220 VAC. $3^{3}/_{4}$Wx$2^{1}/_{4}$Hx$7^{3}/_{4}$D", 1.5 lb. 5-way posts. **MFJ-4215MV, $84.95.** Like MFJ-4115 but has backlit volt/amp meters.

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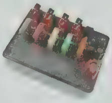
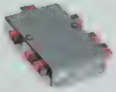
**MFJ-1104, $^{\$}59^{95}$** *PowerPole*$^{(R)}$ Splitter, 30 Amp fused input, outputs fused at 25, 10, 5A. Open fuse indicator. $2^{3}/_{4}$Wx$3^{1}/_{4}$Hx$1^{1}/_{2}$D".



**MFJ-1107, $^{\$}69^{95}$** 40A fused binding posts input, 4 fused *PowerPole*$^{(R)}$ outputs, two 2.1 mm center positive power jacks.



**MFJ-1106, $^{\$}59^{95}$** One in, six out *PowerPoles*$^{(R)}$. 30A total. 7 sets of mating connectors included.

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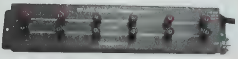
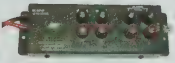
Power multiple transceivers/accessories from a single DC power supply

MFJ-1118, $^{\$}109^{95}$ **Power** two HF and/or VHF rigs and six accessories from rig's 12 VDC supply. 35A high-current and 15A accessory binding posts, Voltmeter, on/off switch. Master fuse, RF bypass. $12^{1}/_{2}$Wx$2^{3}/_{4}$Hx$2^{1}/_{2}$D".

MFJ-1116, $^{\$}74^{95}$ **Like** MFJ-1118 but 15A total, 8 pairs 5-ways."On" LED, 0-25 VDC voltmeter.



MFJ-1112, $^{\$}59^{95}$ **Like** MFJ-1116 but 6 pairs 5-way posts, no meter/switch. $12^{1}/_{2}$Wx$2^{3}/_{4}$Hx$2^{1}/_{2}$D".



MFJ-1117, $^{\$}84^{95}$ **High-current.** Powers four HF/VHF radios simultaneously -- 2 at 35A each, 2 at 35A combined. 8Wx2Hx3D".

MFJ-1129, $^{\$}144^{95}$ **10 outlets.** Installed fuses: two 1A, three 5A, three 10A, two 25A, one 40A. Outlets 1, 2, 4-8 are *PowerPoles*$^{(R)}$. Outlet 3 is a 35A high current post, outlet 9, 10 are 15A posts. Switch, voltmeter. $12^{1}/_{2}$Wx$1^{1}/_{4}$Hx$2^{1}/_{2}$D".

**MFJ-1128, $^{\$}134^{95}$** 12 fused *Power Poles*$^{(R)}$, three 1A, four 5A, four 10A, one 25A, one 40A. Switch, Meter.

**MFJ-1126, $^{\$}104^{95}$** 8 fused *PowerPoles*$^{(R)}$: a 1A, three 5A, two 10A, one 25A, one 40A. Switch, Voltmeter. 9Wx$1^{1}/_{2}$Hx$2^{3}/_{4}$D".

**MFJ-1124, $^{\$}89^{95}$** 4 pairs 35A PowerPoles$^{(R)}$, 2 pairs 35A high current posts.

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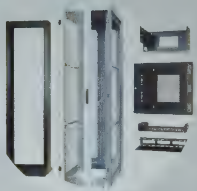

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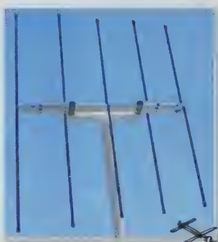

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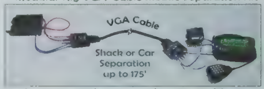

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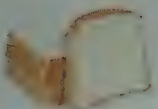

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Determine velocity factor, coax cable loss in dB, length of coax and distance to short/open.

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Read inductance (uH) and capacitance (pF) at RF frequencies.

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Read SWR, return loss, reflect-ion coefficient, match efficiency at any frequency simultaneously.

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Determine velocity factor, coax loss in dB, length of coax and *distance to short or open in feet (it's like a built-in TDR).*

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$349⁹⁵

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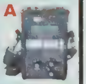

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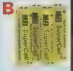

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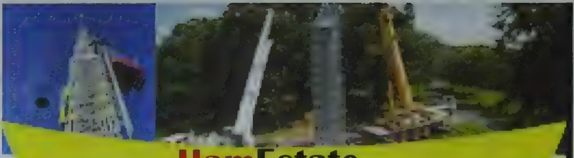

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- Relocation, repairs and servicing nationwide.
- Turnkey station design, installation and automation.
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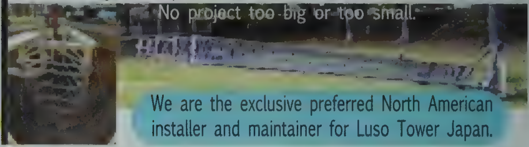

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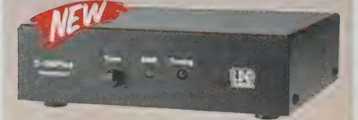
We are the exclusive preferred North American installer and maintainer for Luso Tower Japan.



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ZERO POWER TUNERS

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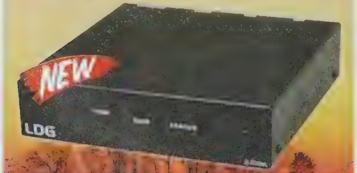
Z-100Plus/IC-705
Zero Power Antenna Tuner
125 Watt power handling, 2000 memories
Full tunes take an average of only 6 seconds.
Now includes 8 AA heavy duty batteries, stereo interface cable, and BNC to PL-259 coax cable.

Z-100A
Plug & Play Operation
Features 10:1 SWR tuning range that matches dipoles, verticals, end-fed wires, G5RVs or even an off-center fed. Goes anywhere with your HF radio... desktops, parks, islands, or tall summits.



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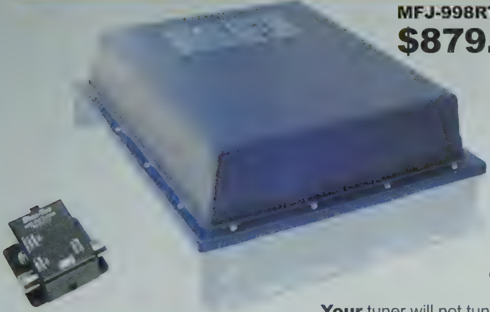
MFJ...the World Leader in Ham Radio Accessories!

MFJ 1500 Watt Remote Auto Tuner

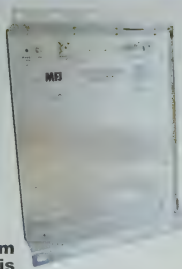
Place this MFJ-998RT remote tuner at your antenna to match high SWR antennas/long coaxes -- greatly reduce losses for high efficiency

. . . Match 12-1600 Ohms, 1.5 kW, SSB/CW/Digital, 1.8-30 MHz . . . Match coax/wire antennas . . . Weather-sealed . . . Remotely powered thru coax . . . Amplifier, radio, tuner protection . . . Output static/lightning protection . . . StickyTune™ always tunes when power folds back . . . DC power jack . . .

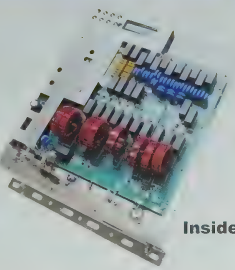


MFJ-998RT

$879.^{95}



Bottom Chassis



Inside View

Tune your antenna at your antenna

Get greatly reduced losses and high efficiencies with long coax runs and high SWR antennas with this new MFJ-998RT 1.5 kW Remote Antenna Tuner.

Weather-Sealed

A tough, durable weather-sealed ABS cabinet with over-lapping lips, sealing gasket and stainless steel chassis protects the MFJ-998RT from all kinds of weather.

No Power Cable Needed!

No power cable needed -- remotely powered through coax. Includes MFJ-4117 Bias-Tee with on/off switch for station end of coax. Has 12 VDC jack for power cable, if desired.

Fully Protected

MFJ exclusive algorithms protect your tuner, radio and RF power amplifier from damage.

Automatic inductor and capacitor limiting prevents tuning extreme loads which can destroy your tuner.

Your tuner will not tune if more than 75 Watts with SWR greater than 3:1 is applied or if more than 125 Watts is applied.

Tuner output is static electricity and lightning induced surge protected.

MFJ exclusive StickyTune™

Very high SWR can fold back transmitter power and prevent tuning caused by extreme differences in loads (example: changing bands and other conditions).

But MFJ exclusive StickyTune™ always tunes with a simple on/off power cycle and re-transmit.

Tunes Coax fed and Wire Antennas

Tunes both coax fed and wire antennas. Has ceramic feed-through insulator for wire antennas. 2 kV Teflon® insulated SO-239 – prevents arcing from high SWR.

High Power, Highly Efficient

A highly efficient L-network matches 6-1600 Ohms at full 1500 Watts legal limit SSB/CW and Digital, 1.8 to 30 MHz with Hi-Q Ls, Cs.

MFJ-998RT Learns as you Operate

As you operate, the MFJ-998RT automatically tunes for minimum SWR and remembers your frequency and tuner settings. The next time you operate on that frequency and antenna, its tuner solution is restored in milliseconds and you're ready to operate!

Highly Intelligent, Ultra-fast Tuning

MFJ InstantRecall™ recalls stored tuning solutions from 10,000 memories. For new frequencies, MFJ Intelli-Tune™ measures your antenna impedance and instantly determines the correct matching components. If antenna impedances cannot be measured, MFJ AdaptiveSearch™ searches only the relevant components that can match your antenna giving you ultra-fast tuning.

Field upgradeable firmware. Requires 12-15 VDC at 1.4 Amps maximum or 110 VAC with optional **MFJ-1316, $34.95**. Weighs 9.5 lbs. 13$^{1}/_{4}$W x 6$^{3}/_{4}$H x 17$^{1}/_{2}$D inches.

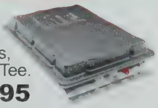
600W Remote IntelliTuner™

MFJ-994BRT – perfect for 600 Watt SSB/CW amplifiers like Ameritron's AL-811/ALS-600/ALS-500M. Matches 12-800 Ohms. Coax/wire antennas, 1.8-30 MHz. Fully weather-sealed for outdoor use. Remotely powered through coax. Tough, durable, built-to-last cabinet, 9$^{1}/_{4}$W x 3H x 14$^{1}/_{4}$D inches, 4 lbs. Includes MFJ-4117 BiasTee Power Injector.

MFJ-994BRT

$469.^{95}

200W Remote IntelliTuner™



MFJ-926B, 200 Watts SSB/CW/Digital, 6-1600 Ohms, Coax/wire antennas, 1.8-30 MHz. Includes BiasTee.

MFJ-926B $339.^{95}

300W Remote IntelliTuner™

MFJ-993BRT handles 300 Watts SSB/CW and digital. Has extra-wide 6-1600 Ohm impedances. Coax/wire antennas, 1.8-30 MHz. Fully weather-sealed for remote outdoor or marine use. Remotely powered through coax. Tough, durable, built-to-last cabinet measures 9$^{1}/_{4}$W x 3H x 14$^{1}/_{4}$D inches. Weighs just 4 pounds. Includes MFJ-4117 BiasTee Power Injector.

MFJ-993BRT

$349.^{95}

MFJ No Matter What™ Warranty

One year **No Matter What**™ Warranty
30 Day Money Back Guarentee
(less s/h) on orders direct from MFJ.

160-6 Meters 43 foot Vertical Antenna

Operate all bands 160-6 Meters at full 1500 Watts with this self-supporting, 43 foot high performance vertical! Assembles in less than an hour. Low profile blends in with sky and trees -- barely see it. Entire length radiates. Exceptional low angle DX performance on 160-20 Meters and very good performance on 17-6 Meters. Telescope it shorter for more effective low angle radiation on 17-6 M if desired. One of these wide range MFJ automatic tuners at the antenna easily matches all bands 160-6 Meters. There's no physical tuning adjustments on the antenna -- you simply put it up! Requires ground system, at least one radial, more the better. Includes balun and base mount. **MFJ-1932, $44.95**. All band ground radial system.

MFJ-2990

$399.^{95}

MFJ **MFJ Enterprises, Inc.** 300 Industrial Pk Rd, Starkville, MS 39759
Phone: (662) 323-5869 ■ **Tech Help:** (662) 323-0549 ■ **FAX:** (662) 323-6551 8-4:30 CST, Mon.-Fri.

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Add shipping. Prices and specifications subject to change. ©2021 MFJ Enterprises, Inc.
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MFJ Tuners

New, Improved MFJ-989D 1500 Watt legal limit Antenna Tuner

World's most popular 1500 Watt Legal Limit Tuner just got better – much better – gives you more for your money!

New, improved MFJ-989D legal limit antenna tuner gives you better efficiency, lower losses and a new true peak reading meter. It easily handles full 1500 Watts SSB/CW, 1.8 to 30 MHz, including MARS/WARC bands.

New, dual 500 pF air variable capacitors give you twice the capacitance for more efficient operation on 160 and 80 Meters.

New, improved AirCore™ Roller Inductor gives you lower losses, higher Q and handles more power more efficiently.

New, TrueActive™ peak reading Cross-Needle SWR/Wattmeter lets you read true peak power on all modes.

MFJ VERSA TUNER V
MFJ
ANTENNA SELECTOR

New, high voltage current balun lets you tune balanced lines at high power with no worries.

New, crank knob lets you reset your roller inductor quickly, smoothly and accurately.

New, larger 2-inch diameter capacitor knobs with easy-to-see dials make tuning much easier.

New, cabinet maintains components' high-Q. Generous air vents keep components cool. 12$^{7}/_{8}$W x 6H x 11$^{5}/_{8}$D inches.

MFJ-989D $479.^{95}

Includes six position ceramic antenna switch, 50 Ohm dummy load, indestructible multi-color Lexan front panel with detailed logging scales and legends.

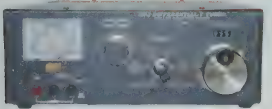
The MFJ-989D uses the superb time-tested T-Network. It has the widest matching range and is the easiest to use of all matching networks. Now with MFJ's new 500 pF air variable capacitors and new low loss roller inductor, it easily handles higher power much more efficiently.

No Matter What™ Warranty

Every MFJ tuner is protected by MFJ's famous one year **No Matter What™** limited warranty. We will repair or replace your MFJ tuner (at our option) for a full year.

More hams use MFJ tuners than all other tuners in the world!

MFJ-986 Two knob Differential-T™



MFJ-986 $429.^{95}

Two knob tuning (differential capacitor and AirCore™ roller inductor) makes tuning foolproof and easier than ever. Gives minimum SWR at only one setting. Handles 3 kW PEP SSB amplifier input power (1.5 KW output). Gear-driven turns counter, lighted peak/average Cross- Needle SWR/Wattmeter, antenna switch, balun. 1.8 to 30 MHz. 15W x 4$^{1}/_{2}$H x 10$^{3}/_{4}$D in.

MFJ-962D compact kW Tuner

MFJ-962D $369.^{95}

A few more dollars steps you up to a KW tuner for an amp later. Handles 1.5 kW PEP SSB amplifier input power (800W output). Ideal for Ameritron's AL-811H! AirCore™ roller inductor, gear-driven turns counter, pk/avg lighted Cross-Needle SWR/Wattmeter, antenna switch, balun, Lexan front, 1.8-30MHz. 10$^{7}/_{8}$W x 10$^{3}/_{4}$H x 4$^{1}/_{2}$D in.

MFJ-969 300W Roller Inductor Tuner

MFJ-969 $269.^{95}

Superb, AirCore™ Roller Inductor tuning. Covers 6 Meters thru 160 Meters! 300 Watts PEP SSB. Active true peak reading lighted Cross-Needle SWR Wattmeter, QRM-Free PreTune™, antenna switch, dummy load, 4:1 balun, Lexan front panel. 10$^{1}/_{2}$W x 3$^{1}/_{2}$H x 9$^{1}/_{2}$D inches.

MFJ-949E deluxe 300 Watt Tuner

More hams use MFJ-949s than any other antenna tuner in the world! Handles 300 Watts Full 1.8 to 30 MHz coverage, custom inductor switch, 1000 Volt tuning capacitors, full size peak/average lighted Cross-Needle SWR/Wattmeter, 8 position antenna switch, dummy load, QRM-Free PreTune™, scratch proof Lexan front panel. 10$^{5}/_{8}$W x 3$^{1}/_{2}$H x 7D inches. **MFJ-948, $199.95**. Economy version of MFJ-949E, less dummy load, Lexan front panel.

MFJ-949E $229.^{95}

MFJ-941E Super Value Tuner

Most for your money! 300 Watts PEP, 1.8-30 MHZ, lighted Cross-Needle SWR/Wattmeter, 8 position antenna switch, 4:1 balun, 1000 volt capacitors, Lexan front panel. 10$^{1}/_{2}$W x 2$^{1}/_{2}$H x 7D in. **MFJ-941EK, $159.95.** Tuner Kit -- Build your own!

MFJ-941E $179.^{95}

MFJ-945E HF/6M mobile Tuner

Extends your mobile antenna bandwidth so you don't have to stop, go outside and adjust your antenna. Tiny 8W x 2H x 6D in. Lighted Cross-Needle SWR/Wattmeter. Lamp and bypass switches. Covers 1.8-30 MHz and 6 Meters. 300 Watts PEP. **MFJ-20, $11.95**, mobile mount.

MFJ-945E $169.^{95}

MFJ-971 portable/QRP Tuner

Tunes coax, balanced lines, random wire 1.8-30 MHz. Cross-Needle Meter. SWR, 30/300 or 6 Watt QRP ranges. Matches popular MFJ transceivers. Tiny 6$^{1}/_{2}$W x 2$^{1}/_{2}$H x 6D in.

MFJ-971 $159.^{95}

MFJ-901B smallest Versa Tuner

MFJ's smallest (5W x 2H x 6D in.) and most affordable wide range 200 Watt PEP Versa tuner. Covers 1.8 to 30 MHz. Great for matching solid state rigs to linear amps.

MFJ-901B $129.^{95}

MFJ-902B Tiny Travel Tuner

Tiny 4$^{1}/_{2}$W x 2$^{1}/_{4}$H x 3D inches, full 150 Watts, 80-6 Meters has tuner bypass switch, for coax/random wire. **MFJ-904H, $179.95**. Same but adds Cross-needle SWR/Wattmeter and 4:1 balun for balanced lines. 7$^{1}/_{4}$W x 2$^{3}/_{4}$H x 2$^{3}/_{4}$D inches

MFJ-902B $139.^{95}

MFJ-16010 random wire Tuner

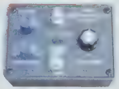
INDUCTANCE
CAPACITANCE
MFJ

Operate all bands anywhere with MFJ's reversible L-network. Turns random wire into powerful transmitting antenna. 1.8-30 MHz. 200 Watts PEP. Tiny 4W x 2H x 3D in.

MFJ-16010 $84.^{95}

MFJ-9201 QRPocket™ Tuner

80-10 Meters, 25 Watts. 12 position inductor, tune/bypass switch, wide-range T-network, BNCs. 4W x 2$^{5}/_{8}$H x 1$^{1}/_{2}$D inches. **MFJ-9201, $64.95**



MFJ-9201 $64.^{95}

MFJ-921/924 VHF/UHF Tuners

MFJ-921 covers 2 Meters/220 MHz **MFJ-924** covers 440 MHz. SWR/Wattmeter. 8W x 2$^{1}/_{2}$H x 3D in

MFJ-921/924 $114.^{95}

MFJ-931 Artificial RF Ground

Eliminates RF hot spots, RF feedback, TVI/RFI, weak signals caused by poor RF grounding. Creates artificial RF ground or electrically places far away RF ground directly at rig. **MFJ-934, $259.95**, Artificial ground/300 Watt Tuner/Cross-Needle SWR/Wattmeter

MFJ-931 $139.^{95}

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The SteppIR Advantage

PROBLEM SOLVED!

Yagi antennas are basically single frequency devices that work well only over a very narrow range, typically 0.5% change in frequency. Fixed length yagis compensate by using a variety of techniques, all of which result in serious degradation of performance, especially in Front to Rear rejection, and added complexity, size, and weight. Dipoles have a much broader bandwidth but still cannot cover the entire 80m and 40m bands and maintain a low SWR (<1.5:1). Our patented solution is to simply adjust all of the antenna elements to the optimal length for the desired frequency with none of the compromises in performance that all fixed antennas require. This is accomplished remotely using an electronic controller that can automatically follow the radios' frequency. SteppIR antennas enjoy optimal performance on all frequencies within their specified frequency range (varies by model), and that includes non-ham radio frequencies as well!

THE INHERENT ADVANTAGES OF A STEPPIR:

Create/Modify Mode

The create modify mode allows the user to change the length of each individual antenna element on all bands of operation -and frequencies outside the ham bands as well – and then save the new antennas to memory. This can be incredibly useful to "tune" out potential objects that may be causing interaction with the SteppIR antenna, or to create your own custom antenna designs.

180 Degree Mode

The 180 degree mode feature is one of the most popular among SteppIR owners. For our Yagi antennas, this feature allows a user to electrically "rotate" the antenna from the forward beam heading, to the reverse (180 degrees) beam heading, with a click of a button – the entire process takes approximately 2 seconds.

Bi-Directional Mode

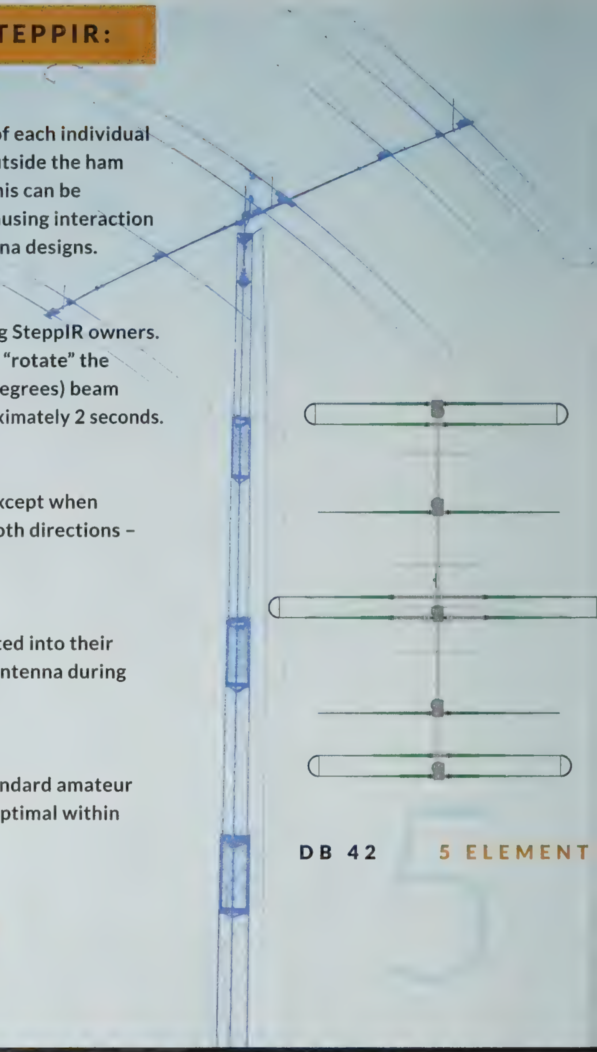
The bi-directional mode works similarly to the 180 function, except when enabled, the Yagi antenna will now be operating with gain in both directions – forward and backwards, simultaneously!

Retract Elements

With a touch of a button, SteppIR antennas can be fully retracted into their housing, which helps to protect the most valuable part of the antenna during extreme weather events.

Emergency Communications

Many times, emergency communications occur outside the standard amateur radio allocated bands of operation. All SteppIR antennas are optimal within the entire scope of their specified frequency range.



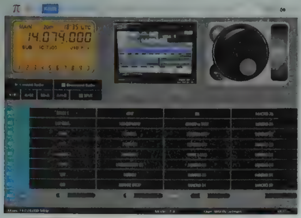
steppIR
COMMUNICATION SYSTEMS

SEE ALL OF STEPPIR'S ANTENNAS: www.steppir.com 425-453-1910

New! Ver. 2.0

MFJ-1234B . . . Remotely operate your transceiver from anywhere in the world!

MFJ-1234B has RigPi version 2 software with new powerful Raspberry Pi 4B with 2 GB RAM. Loaded with 30 new features and updates and provides remote CW keying over the internet, support for over 27 new radios, PTT and frequency control knob from the Contour Shuttle controller and Flic Bluetooth PTT switch, antenna switching, power amp control and much more!



New! MFJ-1234B **$329.95**

Apple iPhone operating your rig remotely from anywhere in the world!

Remotely operate your station! Use any web browser on your mobile phone, iPad, tablet, laptop, desk-top even a Kindle!

Use nearly any transceiver with CAT control, old or new. Operate all modes SSB, CW, FM, digital. WSJT-X, Fldigi are installed.

Control from anywhere via the internet using any browser -- radio, rotor, CW keying, VoIP, digital modes, logging, spot monitoring, callbook lookups, more.

Look-up calls using included FCC database or optional QRZ subscription. Monitor DX spots for un-worked or unconfirmed calls.

Design, maintain multiple logs. Upload ADIF logs to ARRL LoTW server. Send CW from a mobile device, keyboard or paddle.

32 programmable macros.

Two or more hams from different locations can operate different radios at the same time using one MFJ-1234.

Single-click updating, I/Q Input for SDR radios, onboard VoIP server gives outstanding 2-way audio.

Includes email, word processing, spreadsheet programs, 1000's of Linux programs, including many for ham radio. Modify, program RigPi Station Server features using a text editor.

HARDWARE

RSS is a Raspberry Pi™ computer running Linux and RigPi Keyer and Audio boards. RigPi Keyer uses K1EL WinKeyer3 integrated circuit for keyboard/paddle input. RigPi Audio is used for VoIP for remote, digital modes and I/Q spectral display (Panadaptor).

OPTIONS

MFJ-1305RP, $29.95. 5V, 3A Pwr Supl.
MFJ-1234BSD,$59.95. RigPi 2.0 software on SD Card only.
MFJ-1234BOS, $29.95. Rig Pi Version 2.0 software download.
MFJ-1234AB, $79.95. Audio Board.
MFJ-1234KB, $79.95. Keyer Board.
MFJ-1234BC, $29.95. Metal cabinet for Raspberry Pi 4B, audio, keyer boards.

TECH HELP

- RigPi forum is *https://rigpi.groups.io*
- RigPi website is *https://rigpi.net*

** RigPi trademarked, Howard Nurse, W6HN. Raspberry Pi is a trademark of the Raspberry Pi Foundation*

MFJ CW *Reader and Keyer* Combination

MFJ-464 **$249.95** *(Keyboard, paddle not included.)*

Plug MFJ's CW Reader with Keyer into your transceiver's phone jack and key jack.

Now you're ready to compete with the world's best hi-speed CW operators -- and *they won't even know you're still learning the code!* Sends and reads 5-99 WPM.

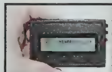
Automatic speed tracking. Large 2-line LCD shows send/receive messages. Use paddle or computer keyboard.

Easy menu operation. Front panel speed, volume controls. 4 message memories, type ahead buffer, read again buffer, adjustable weight/sidetone, speaker. RFI proof.

MFJ-551, $39.95. RFI suppressed keyboard, a must to avoid RFI problems.

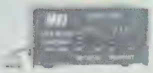
MFJ Pocket-Size *CW Reader™* and *Code Tutor*

MFJ-461, $119.95. Place this tiny pocket size MFJ Morse Code Reader near your receiver's speaker and watch CW turn into solid text messages as they scroll across an easy-to-read LCD. No cables to hook-up, no computer, no interface, nothing else needed! Practice by copying along with the MFJ-461. Learn the code and increase your speed as you instantly see if you're right or wrong. Eavesdrop on interesting Morse QSOs from hams all over the world. MFJ's *AutoTrak™* automatically locks on, tracks and displays CW to 99 WPM. Serial port lets you display full screen CW text on your computer monitor with your computer and terminal program. Tiny $2^1/_4$x$3^1/_4$x1", $5^1/_2$ oz. Fits in your shirt pocket, take it anywhere. Use 9 Volt battery.



MFJ-418, $119.95. Morse Code Tutor. Learn Morse code anywhere! Copy letters, numbers, prosigns or any combination or words or QSOs. ARRL/VEC format. Go from zero code speed to a high speed *CW Pro!* High contrast LCD, built-in speaker.

Plug & Play FT-8 and all Digital Modes!



MFJ-1205, $119.95. *Plug&Play* all digital modes! Specify your radio when ordering and just plug USB cable into your computer. Download *free* software from internet and operate: FT-8, JT4, JT-65, JT6M, FSK441, WSPR, PSK-31, EchoLink, APRS, CW, RTTY, packet, Amtor, more. Easy-to-set transmit/receive levels. Transformer isolated audio, PTT sensing eliminates adjustments. Universal, never obsolete.

MFJ-407E Deluxe CW Keyer $129.95

MFJ Curtis-Keyer has all modes, dot-dash memories, jam-proof spacing, weight, sidetone, built-in speaker. Speed, weight and tone controls and tune, semi-auto and on/off are on front panel.

MFJ-557 Code Oscillator/Key $69.95

Practice sending Morse code. Telegraph key, code oscillator, speaker on heavy non-skid steel base. Volume/tone controls. Use 9V battery.

MFJ-550, $24.95. Key only.

MFJ-561 Tiny Iambic paddle $39.95

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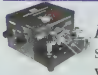

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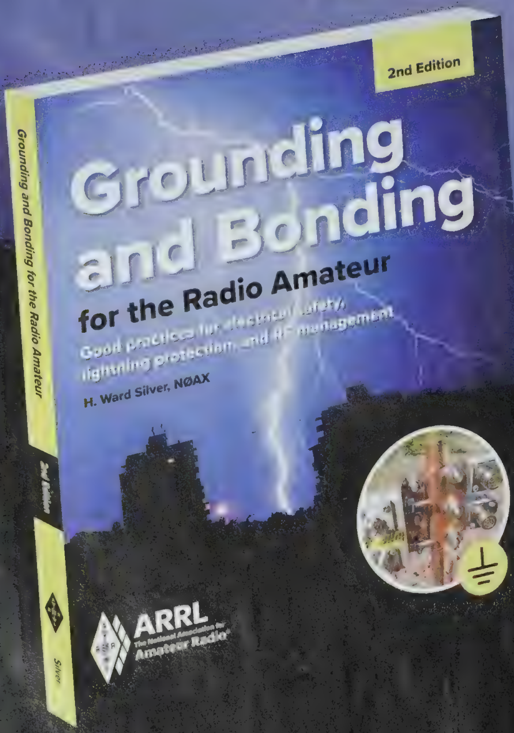

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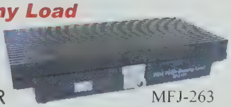

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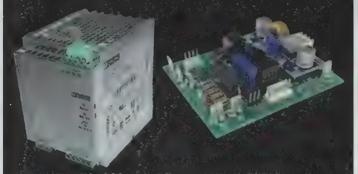

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QST Index of

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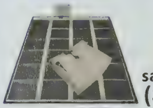
Alpha Delta Radio Communications, LLC – www.alphadeltaradio.com 125
Ameritron – www.ameritron.com 17
Arcom Communications – www.arcomcontrollers.com 108
Array Solutions – www.arraysolutions.com 12
ARISS – www.arris-usa.org/donate 106
ARRL – www.arrl.org 26, 100, 104, 108, 110, 112, 122, 128
BeLoud.US – www.beloud.us 100
bhi Ltd – www.bhi-ltd.com 112
Bioenno Power – www.bioennopower.com 126
BridgeCom Systems – www.BridgeComSystems.com ..... 22, 23, Cover 3
Buckmaster International LLC – www.hamcall.net 108
Cable X-Perts, Inc. – www.CableXperts.com 108
California Peripherals & Components, Inc. – www.Californiapc.com 126
Cushcraft – www.cushcraftamateur.com 2
Dr.Duino – www.drduino.com/qst 6
Diamond Antenna – www.diamondantenna.net 8
DX Engineering – www.DXEngineering.com 25
Elecraft – www.elecraft.com 19
Elk Antennas – www.ElkAntennas.com 114
Eventide – www.eventidecommunications.com 125
Expert Linears America, LLC – www.ExpertLinears.com 106
FlexRadio Systems – www.flex-radio.com 21
Global TSCM Group, Inc. – www.kn2c.us 112
Greater New Orleans Ham Fest. – (504) 288-7084 116
Green Heron – www.greenheronengineering.com 110
Ham Ads – www.arrl.org/ham-ad-listing 124
HamEstate – www.hamestate.com 116
Ham Radio Outlet – www.hamradio.com 98, 99
Hammond Mfg. Co. – www.hammondmfg.com 114
Hy-Gain – www.hy-gain.com 10, 103
ICOM America – www.icomamerica.com 101



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Mosley Electronics – www.mosley-electronics.com	116
Motosports of Ukiah – www.hondashop.com	114
NCG Company – www.natcommgroup.com	3
OCI-Olds Communications Inc. – www.ocicom.com	127
Pacific Antenna – www.qrpkits.com	104
Palomar Engineers – www.Palomar-Engineers.com	112
PreciseRF – http://preciserf.com	11
PreppComm – www.preppcomm.com	108
Quicksilver Radio Products – www.qsradio.com	27
Radio Club of JHS 22 NYC – www.wb2jkj.org	110
RFC2 – www.rfc2.com	100
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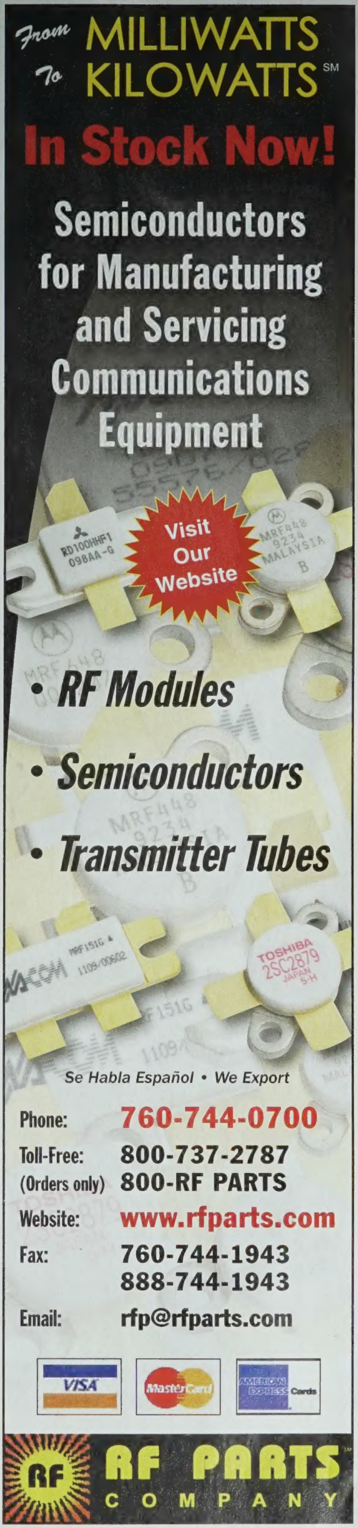
SteppIR Communications Systems – www.steppir.com	7, 120
SwapMyRigs – www.swapmyrigs.com	114
Tac-Comm – www.tac-comm.com	112
Ten-Ten International Net, Inc. – www.ten-ten.org	104
Tigertronics – www.tigertronics.com	106
Timewave Technology, Inc. – www.timewave.com	102
UltraTek. – www.flipperUSB.com/clocks.pdf	126
Unified Microsystems – www.unifiedmicrosystems.com	126
W5SWL Electronics – www.w5swl.com	114
Warren Gregoire & Associates – www.superbheadsets.com	126
West Mountain Radio – http://www.westmountainradio.com	18
Wireman – www.coaxman.com	112
Yaesu USA – www.yaesu.com	Cover II, 1

Filters
Ham - Commercial - Band Pass
www.ocicom.com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To learn more about the ARRL Foundation Scholarship Program, please visit www.arrl.org/scholarship-program.

Clubs or individuals interested in creating a scholarship should contact
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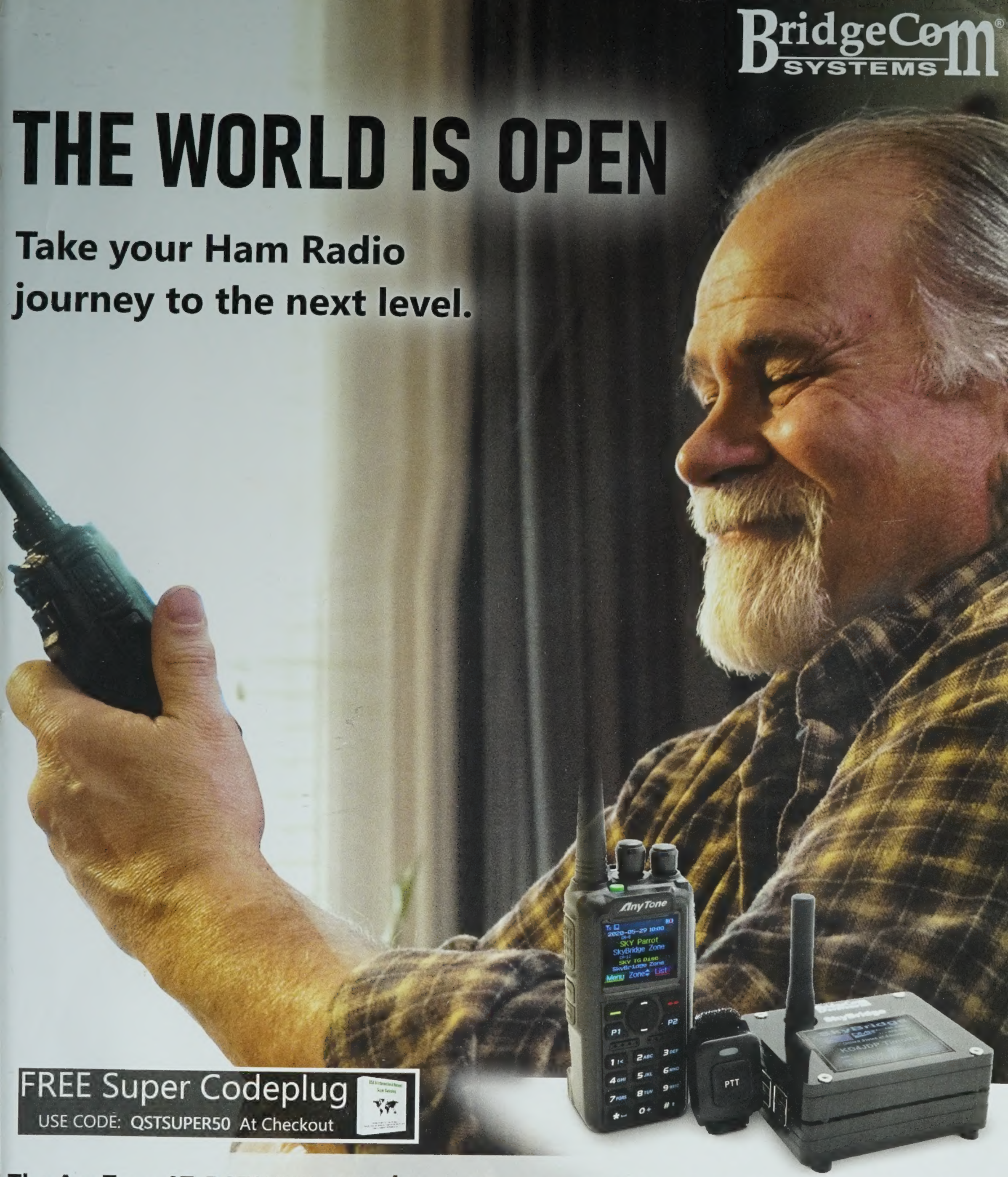
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